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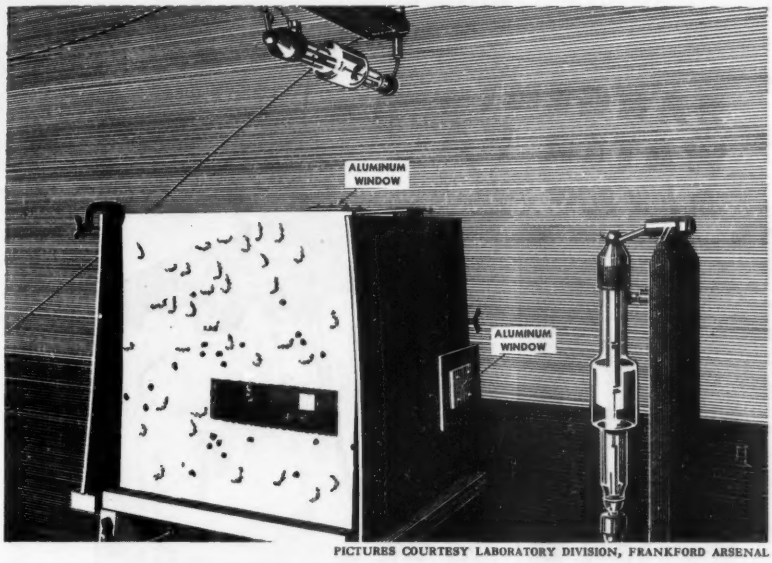

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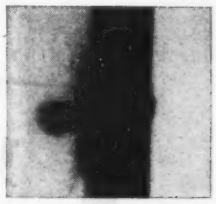

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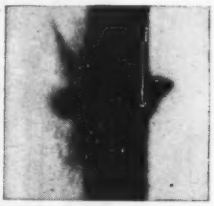

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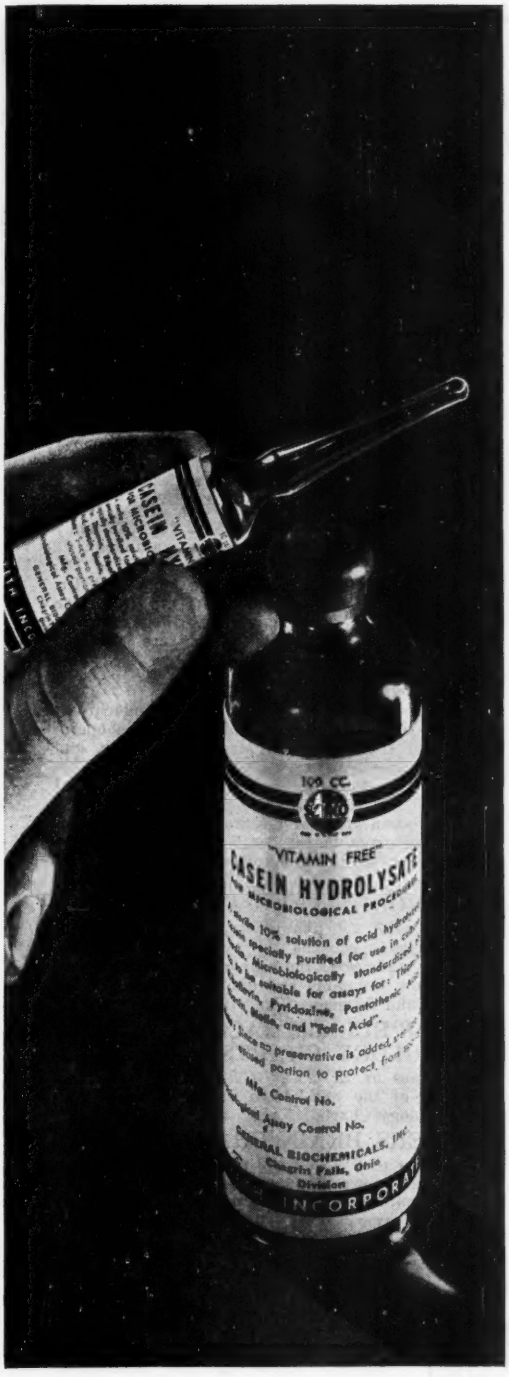

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AMERICAN MATHEMATICS IN THE PRESENT WAR[1]

By DR. M. H. STONE

PRESIDENT OF THE AMERICAN MATHEMATICAL SOCIETY

THE topic of my remarks this evening is a rather serious one to take up after a dinner so pleasant and so friendly as the one we have all been enjoying. Moreover, I fear that the tone of my discussion can not be altogether gratifying to our professional pride, since the history of American mathematics in the present war has been in many respects a story of frustration. I believe, however, that we should all look at the record at this moment when the urgency of our national cause gives every detail of that record the fullest possible significance—and yet at a time when the inevitable note of protest can in no sense be interpreted as obstructing positive achievements on the part of those charged with the ultimate responsibility. The fact is that important lessons can be drawn from a recital of the record; and this is the time to draw them.

The history of American mathematics in the present war is complex and can be approached in a variety of different ways. I was rather at a loss to choose among them until finally the circumstances of this essay into historical expression made it clear to me that the most satisfactory plan would be to trace the sequence of events against the time-scale of the war itself. With this point of view in mind I spent part of the afternoon in drawing up a chronological table which I propose to follow this evening.[2] With all the cross-links displayed, I must confess that my chart is reminiscent of a topologist's nightmare!

Many of you will recall our summer meeting in Madison five years ago. That meeting began only a few hours after the invasion of Poland. The long-

[1] This paper represents the final version of an address delivered on August 13, 1944, before the American Mathematical Society at its summer meeting in Wellesley, Massachusetts.

[2] See the chart presented on page 533.

feared advent of war in Europe abruptly confronted us with concrete problems which called for our closest and most immediate attention. There were two steps which, it was felt, could and should be taken without delay; and both were completed before we left Madison. First of all, it was necessary to carry through the formal suspension of the elaborate plans, so long a-making, for an International Congress of Mathematicians to be held at Cambridge, Massachusetts, in 1940, and to file them safely away against some more propitious time. Also we knew that we must already look ahead to the possibility that our country would be drawn into the war and would then find urgent uses for our professional skills as it had in 1917–1918. It was decided to create a War Preparedness Committee[3] to guide our joint endeavors in making ourselves ready. During the three years following its formation, this committee bore the burden of organizing our voluntary efforts, until finally it was discharged in December, 1942. From the beginning the committee saw clearly that it would be concerned with several quite distinct kinds of activity—with educational services at various levels, for instance, and with research designed to increase the nation's military effectiveness along technical lines. With the experiences of 1917–18—and very little else—as a guide, the committee was at first hardly in a position to do more than to sketch out the lines along which it would later intensify its efforts. Indeed, as one looks back on the first months of the war, it is quite vividly apparent that awareness of impending catastrophe was still withheld from even the best informed. Under those circumstances it was not astonishing that the committee could discover no very active or perspicacious interest in its future services on the part of the Army or the Navy or of any other official body.

The appalling collapse of the French Army in June, 1940, aroused the nation to a sense of its peril and quickened the preparations for defense which had already been quietly begun. The activities of the committee were infused with a new sense of urgency and were given a much more definite direction. The atmosphere of apprehension which prevailed brought the committee its first opportunities for making contacts with governmental and other agencies which were then beginning to take open and public action to meet the impending danger. It was at that time that the committee, on behalf of the entire mathematical profession, made its first tentative offer of our services to the military establishments and to the then newly created National Defense Research Committee (N.D.R.C.). Apart from receiving acknowledgments of its offer, the committee made little progress towards a more specific understanding of its potential usefulness in the national emergency.

The 1940 summer meeting of the society was held in September at Dartmouth College. The program of addresses reflected the concern of the society, and of the committee, for the future: a number of the speakers had been invited to discuss mathematics of immediate relevance to the national defense. No program could have been more timely, when one recalls that the Battle of England began just at that moment. It is interesting to recall, too, that the speakers on ballistics at that meeting left us with a certain impression that the Army was then entirely prepared to handle its ballistic problems and probably would not require very extensive services from members of the mathematical profession. So far as the committee was concerned, the Dartmouth meetings were the occasion for a tightening and strengthening of its internal organization. Still guided largely by the lessons of 1917–1918, the committee formed three subcommittees to deal respectively with its three major problems. One of these subcommittees was to be concerned with basic teaching at the college level in the interests of the Armed Forces; a second with instruction and self-preparation at more advanced levels intended to equip the mathematically skilled with technical tools and information which would be specifically useful in war work; and a third with the actual research work which might, it seemed, be requested at any time in aid of the nation's military preparations. It was evident in the succeeding months that this scheme of organization was fundamentally sound. Yet it must be admitted, I think, that the great difficulty during those confused times lay in giving a more precise orientation to sound general principles in the absence of clear understanding and purpose among the authorities charged with the responsibility for the ultimate decisions. For example, we were quite correct in our estimate that the teaching of basic mathematics through the calculus to officer candidates and technicians would prove to be one of the major tasks of our profession in the years which lay ahead. But, on the other hand, the Armed Services—especially the Army—then showed no clear realization of the extent to which the building of our forces would involve them in this educational problem. In consequence a good part of our professional efforts in this field were ex-

[3] In its final form this committee was organized as follows: *General chairman:* Marston Morse; *Subcommittee on Research:* Dunham Jackson (*chairman*), Harry Bateman, E. J. McShane, M. H. Stone, J. H. Van Vleck, Norbert Wiener, S. S. Wilks; *Subcommittee on Preparation for Research:* M. H. Stone (*chairman*), B. O. Koopman, R. E. Langer, Hans Lewy, F. D. Murnaghan, H. P. Robertson; *Subcommittee on Education for Service:* W. L. Hart (*chairman*), R. S. Burington, J. L. Coolidge, H. B. Curry, E. C. Goldsworthy, F. L. Griffin, M. H. Ingraham, E. J. Moulton; *Consultants:* Aeronautics—Harry Bateman, *chief;* Ballistics—John von Neumann, *chief,* W. T. Reid; Computation—Norbert Wiener, *chief;* Cryptanalysis—H. T. Engstrom, *chief,* A. A. Albert, W. A. Hurwitz, Solomon Kullback, Oystein Ore; Industry—T. C. Fry, *chief;* Probability and Statistics—S. S. Wilks, *chief.*

erted on a local, individual basis through university, college or departmental organizations without any compelling or authoritative influence toward unification. Under the circumstances the committee could do little more than to stimulate local planning and to facilitate exchange of information among the active groups. Conditions in the other fields in which the committee worked were not dissimilar. It may indeed be said that the lack of any clear and specific demand for the kind of mathematical work which ultimately proved to be indispensable to the national security resulted in a definite retardation of the essential process of converting research mathematicians and talented students of mathematics from their peace-time orientation to a war-time one.

Nevertheless, it is my firm belief that the response of our profession to the obvious need for such a reorientation will come to be regarded as one of the interesting and significant episodes in the history of mathematical teaching in the United States. In order that mathematicians at various stages of advancement might be instructed in such obviously-to-be-used subjects as aerodynamics, ballistics, optics, and so forth, institutions all over the country introduced higher courses on applied mathematics of various kinds—in addition to those which were already well established. Usually the direction of this development depended upon local conditions, such as the availability of instructors or the presence of interested industrial neighbors. In many cases, such courses were sponsored by the U. S. Office of Education, which contributed funds to make them possible. The society exerted a certain influence in this direction not only through the War Preparedness Committee but also through a special committee appointed to arrange a program of addresses and symposia on applied mathematics in connection with the regular meetings.[4] No doubt the most ambitious and one of the most effective enterprises in the field of applied mathematics was the program inaugurated at Brown University with such conspicuous success. Having had the honor to be associated for some time with the Brown program in an advisory capacity, I may be pardoned if I now express my belief that the program has broken paths in the domain of American mathematical education which others too will follow and extend. There is no question, in any case, that as a war-time activity the Brown program has thoroughly proved its value in the training of needed technicians of the highest caliber. I am convinced that it and similar schools have before them a bright peace-time future, in which members of our profession will continue to enjoy genuine opportunities, hitherto all too rare in the United States, of preparing students for specifically technological careers involving industrial applications of higher mathematics.

When the invasion of Russia began in June, 1941, our profession was far from being drawn into adequate contact with the national mobilization which was then gathering speed. Matters were advanced little further by the time of our summer meeting, held that year in September at the University of Chicago. One problem which was discussed at the meeting there, on the basis of a report from a special committee,[5] was the one which was injected into our professional deliberations by the Selective Service Act of 1940. In due time the operations of the act were to occupy a great deal of our professional time and attention; but in those early days we did not yet realize the extent to which we would have to rely on our own efforts to prevent the depletion of our professional ranks below the level needed for the performance of essential wartime mathematical services. Indeed, our first reaction, as formulated at Chicago, was to take only the most restrained measures and to make only the most limited representations to General Hershey's office. Later we were disabused of our hopes that the provisions of the act, and those of the Army for the assignment of technically trained selectees, would be administered in such a way as to keep the nation's scientific potential at its highest during the war and during the early years of the peace to follow. But of this I shall speak at greater length a little later on.

So far I have touched exclusively upon matters which fell within the scope of the War Preparedness Committee or of other committees in the society. But I shall now digress to pick up the story of other, quite unofficial, efforts which have not been made a matter of record before to-night. The events which I am about to relate seem to me to form a small but vital part of the scientific history of the war. They originated at the Chicago meeting in 1941. It will be recalled that in June of that year President Roosevelt by executive order created the Office of Scientific Research and Development (O.S.R.D.), absorbing therein as a subordinate unit the National Defense Research Committee. This visible expansion of the Government's scientific activity in the interests of national defense had inspired hopes in various quarters that greater use would immediately be made of the whole range of scientific resources of the country than had been physically possible in the preceding stages. By September, when the Chicago meeting brought many of us together, it was apparent that such hopes were not likely to be very rapidly realized so far as mathematics might be concerned, unless the mathematicians bestirred themselves. In consequence steps were taken

[4] Richard Courant (*chairman*), R. M. Foster, Harold Hotelling, R. G. D. Richardson.

[5] Committee on Supply and Demand for Mathematicians: T. Y. Thomas (*chairman*), Harry Bateman, E. T. Bell, G. C. Evans, W. M. Whyburn.

to form a small group of mathematicians who could speak in this matter for all of us without being in any sense official representatives of the society or of the Mathematical Association. As finally constituted, this group consisted of the following: G. A. Bliss, G. C. Evans, Dunham Jackson, Marston Morse and M. H. Stone. In due course, the group drew up a memorial setting forth its views on the use of mathematics in the work of the N.D.R.C. and requested Chairman Conant of that body to receive Professors Morse and Stone as delegates to submit the memorial. A meeting was finally arranged to take place at Washington in the early spring of 1942. Chairman Conant and Dr. Jewett, the latter in his capacity as a member of N.D.R.C., received Professors Morse and Stone; and Dr. Vannevar Bush, chief of the O.S.R.D., joined the meeting a few minutes after it had convened. After the memorial had been presented as a document and its substance had been outlined orally by the two delegates, Dr. Bush and Dr. Conant at once put forward the proposal that a formal committee on mathematics be appointed by Dr. Jewett, in his capacity as president of the National Academy of Sciences, to function within the academy and the National Research Council. I hardly need say that this solution did not correspond to the views expressed in the memorial. Nevertheless, the alacrity with which it was put forward suggested that a full consideration by the O.S.R.D. of the more fundamental solution sought in the memorial which had just been presented was very unlikely. The meeting broke up in about an hour on the conclusion that the Committee on Mathematics should be appointed as I have just described it; and this was later done and made a matter of record.[6] While this committee, as a consultative body, performed a number of useful functions, especially in connection with research problems of interest to the Navy Department, very little use was ever made of it by O.S.R.D. or N.D.R.C. Under the circumstances of its formation it is of peculiar interest to observe that the committee was not consulted in any way when, at a later time, the N.D.R.C. became aware of its own vital need for a mathematical organization to handle its mathematical problems and thereupon created the Applied Mathematics Panel as one of its units. Before speaking again of the panel, I wish to emphasize the fact that the Committee on Mathematics, divorced as it was from the functioning organization of the O.S.R.D. and supplied with quite negligible funds, was able to do great good—though on a rather limited scale—by the simple but fundamental process of facilitating contacts between first-class mathematicians and difficult technical problems which were held secret by the Services for reasons of security. The projects which the committee helped launch have since found lodgment in appropriate places and have proved to be of real value. The committee itself still exists and may perhaps now be called upon to perform an entirely different function within its own parent organizations.

Let me remind you that the events I have just been describing took place almost without exception *after* the attack at Pearl Harbor. They illustrate the conditions affecting the mobilization of American mathematics throughout the entire first year of our active participation in the war. There was in fact nothing resembling a systematic mobilization of our mathematical resources to be discerned during most of 1942, though an increasing number of individuals found their way into war work of a mathematical nature and an increasing number of others prepared to join them. The need for mathematicians, while not yet very clearly understood by the authorities, was inherent in the development of important scientific projects in the Army, the Navy and the O.S.R.D. and became pressing by the end of the year. During this same period, the draft was creating ever more difficult problems for our profession even as its war usefulness increased and the prospects of a heavy teaching task for the growing Army and Navy became more certain. So it was that one year after the United States entered the war, there were very few who knew whither we were going, mathematically speaking.

Just at that moment, a number of important organizational changes were made. The N.D.R.C. revised its own internal arrangements and took the opportunity to provide itself with a mathematical arm, the Applied Mathematics Panel, in order to deal more effectively with one aspect of its numerous and ramified activities. The society and the association, impressed by the growing urgency of the Selective Service problem and the increased need for governmental contacts at many different points, decided to set up a joint War Policy Committee[7] responsible to the governing bodies of the two organizations but nevertheless equipped with somewhat vaguely defined powers of action rather wider than those granted the War Preparedness Committee, which it replaced, the latter being discharged in December, 1942, after three years of faithful and devoted service.

The creation of the Applied Mathematics Panel and the selection of its chief in the person of Dr. Warren Weaver, well known to all of us as a member and an officer of the society, gave us every reason to believe that the relations between the N.D.R.C. and the mathematical profession would become more cordial than they had been hitherto and would re-

[6] Marston Morse (*chairman*), Walter Bartky, Harry Bateman, G. D. Birkhoff, G. C. Evans, Dunham Jackson, H. P. Robertson, M. H. Stone, Oswald Veblen, Warren Weaver.

[7] M. H. Stone (*chairman*), W. D. Cairns, G. C. Evans, L. M. Graves, Marston Morse, Warren Weaver, G. T. Whyburn.

sult naturally in the rapidly increased enlistment of our outstanding mathematical talents in the war effort. I regret to say that these hopes were quickly discouraged, if not entirely dashed, by the realization that the panel would display considerable reluctance to call on the leaders of our profession or to seek out those talents which had displayed themselves in the field of pure mathematics as distinct from applied. While this state of affairs has been altered with the growth of the panel, it is nevertheless true that only comparatively recently could the direction and constitution of the panel be regarded as in any way representative of our profession as a whole. It is my considered judgment that the principles which appear to have guided the panel have been reflected in certain unfortunate consequences, for which our profession should explicitly disclaim the responsibility. Let me hasten to add, in the same breath, that none of us should desire by such a disclaimer to detract from the positive achievements of the panel or to withhold honor from those mathematicians whose individual contributions to its work are found deserving of our deepest scientific respect. In appraising the work of the panel, when the time comes to do so, it should be remembered also that a great many of our ablest mathematicians are now working directly for the Army or the Navy, where their achievements have an even closer bearing upon the scientific and technological aspects of the war and are likely in the long run to receive far less public attention.

The replacement of the War Preparedness Committee by the quite differently organized War Policy Committee provided our profession with a machinery which seems to have functioned reasonably well in handling the problems of military training and selective service in which we have been extensively involved from the beginning of 1943 to the present. The War Policy Committee, modeled upon the like-named committee of the American Physical Society, was authorized to represent and to act for both the society and the association. While its authority was never very precisely defined, the committee has always acted promptly and without hesitation in reference to the various war problems which have arisen since its formation. I hope and believe that it has acted with discretion though that is, of course, a matter for the governing bodies of our two organizations to decide. In any event, the committee has had a tangible and increasing influence and will undoubtedly prove to be a most useful instrument for taking up the many important tasks which will come to us during the remainder of the war and during the subsequent period of reconstruction.

The role played by the committee can be most clearly seen in the history of our relation to the various educational programs instituted by the Armed Services. From the beginning the Army and the Navy have sought some professional advice in setting up the mathematical parts of their training programs. Often, I regret to say, the consultation has been somewhat belated or rather on the perfunctory side; but on other occasions it has been serious and fruitful. The contrast between the planning of the Army Specialized Training Program and that of the Army Air Forces Meteorological Program comes to mind as an illustration. Our profession was well represented in the planning and administration of the meteorological program, with what I believe to have been outstandingly good results. On the other hand, the plans for the mathematical courses under A.S.T.P. were brought close to maturity before a small number of professional mathematicians familiar with collegiate teaching problems had a brief, last-minute opportunity to contribute to

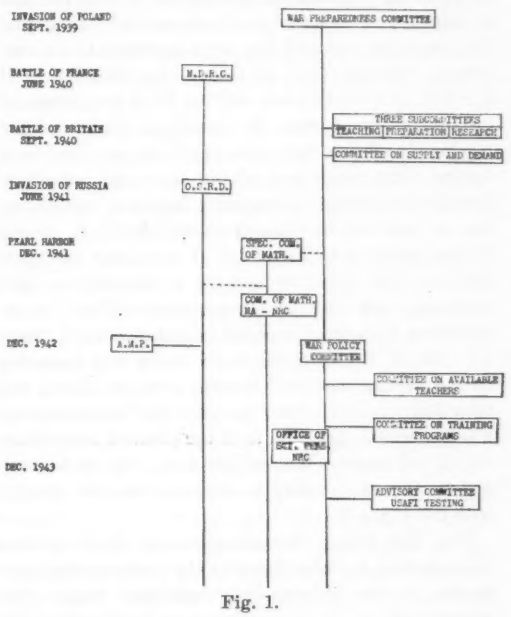

Fig. 1.

those plans. Indeed, it was felt in some quarters that the contrast between the vastness of this program, of which at least twenty per cent. involved collegiate mathematics, and the pitifully small number of man-hours spent by members of our profession in official consultation over it actually bordered upon the absurd. Fortunately the departures from normal teaching procedures were not so radical as to produce any grave or serious difficulties. I should add, too, that the men in charge of the A.S.T.P. had so many more troublesome problems to resolve in their planning that the time given by them to examination of the mathematical problems could not have been expected to be

anything but relatively limited. Whatever uneasiness may have been caused by initial lack of contacts, I would say that the tendency soon established was the one, most satisfactory to us, of relying increasingly upon the knowledge and experience of members of our profession, not only in the planning of courses but also in the highly important operation of testing. The War Policy Committee has helped supply consultants when requested and has also taken the initiative in preparing critical studies of certain of the service programs. For the latter purpose it created sometime in the summer of 1943 a special subcommittee[8] which has prepared two careful and detailed reports, one on the A.S.T.P. and the other on the Navy V-12 and related programs. Copies of these reports were forwarded to the competent authorities in each case and appear to have been received in a cordial and interested spirit. It has certainly been our desire in undertaking these studies to turn our critical remarks in helpful and constructive directions and I trust that this desire on our part has been apparent to all concerned. At this time, of course, the elimination of A.S.T.P. is well advanced and the Navy programs are no longer expanding. In consequence the related teaching problems have lost their urgency and now occupy very much less of our time and attention. Another important opportunity has been opened up for us, however, in connection with the U. S. Armed Forces Institute (U.S.A.F.I.). I am happy to report that we were asked to appoint a consultative committee to work with the examinations staff of the institute on the testing problem in mathematics.[9] Since the aim of the institute is to foster self-education among service men and women, some of whom will later desire college credits for what they have achieved, a sound testing program is of the greatest importance for all concerned. We are therefore very much gratified by the opportunity to cooperate in this manner with the U.S.A.F.I.

The War Policy Committee exerted itself in other ways as well in order to assist the mathematical profession in the training responsibilities which were placed upon it. A modest but most useful effort was made through the Subcommittee on Available Teachers of Collegiate Mathematics[10] to assist in the readjustment of teaching staffs in response to the requirements of the service programs. While the operations of this subcommittee have been carried out on anything but a large scale, they appear to have filled a real need. There is every reason for us to continue the work of this subcommittee, especially through the reconstruction period when there will undoubtedly be extensive realignment of college staffs as the effects of the war are gradually unscrambled. Through generous grants from the Rockefeller Foundation, the War Policy Committee has been enabled to lend support to the Office of Scientific Personnel in the National Research Council. In company with other scientific groups we have thus been in the position of fostering an office which, directed until recently by Dr. Homer Dodge and at present by Dr. M. H. Trytten, has made most valuable contributions to solving the problems of personnel placement in the scientific field. On our side we have derived special benefit from our association with the office by virtue of its great usefulness as a source of information concerning the often erratic operations of the Selective Service System and of the War Manpower Commission, all of which we have had to follow as closely as possible since the time when the need for mathematicians became really critical.

The experiences of the War Policy Committee in meeting the responsibility imposed upon it by this critical need would take a much longer time to recount than I have at my disposal this evening. We were very fortunate in having the aid and advice of physicists who had already acquired much experience relevant to the problems we ourselves had to face from the moment when it became apparent that A.S.T.P. and the Navy V-12 programs would require the maintenance of full or expanded teaching staffs in universities and colleges all over the country. Nevertheless the negotiations which had to be undertaken with the Washington authorities in order to protect mathematics departments and research groups against crippling inroads at this critical time were difficult and often disappointing, even though they were attended with a certain measure of success. From my own observations—especially those made during a brief term as departmental chairman—I have the impression that in general the local selective service boards have understood the usefulness of scientists in the war effort and have made intelligent efforts, within the scope of Washington's directives, to keep our young scientists at scientific work. If we have had trouble, it has been mainly in persuading the Washington authorities to issue directives which would be intelligent guides for the work of the local boards. Fortunately the profession of mathematics was included during the most critical period in the long list of essential occupations and activities drawn up by Selective Service Headquarters. For a short time an interesting and, I believe, most progressive device for handling the deferment problems at professional levels was placed in operation in Washington. After most strenuous persuasive efforts on the part of various scientists, Selective Service set up in the National Roster of Sci-

[8] W. L. Hart (*chairman*), C. R. Adams, H. M. Bacon, Ralph Beatley (replacing G. B. Price), B. H. Brown, H. J. Ettlinger, C. V. Newsom, W. M. Whyburn.

[9] W. T. Reid (*chairman*), Ralph Beatley, L. L. Dines, W. L. Hart, C. C. MacDuffee.

[10] W. D. Cairns, Arnold Dresden, J. R. Kline.

entific and Specialized Personnel an official advisory committee, finally known as the National Committee on Physicists and Mathematicians, with the primary function of advising local boards and appeal boards on the merits of scientific grounds put forward in support of requests for individual deferments. Our own contacts with this committee were notably short-lived, since our representatives began their services as members of the committee just in time to witness its dissolution as a result of bureau politics at their worst. The disappearance of this committee was a bitter disappointment, since it gave real promise of providing an intelligent, democratic and practical solution to our deferment problems. However, enough had been accomplished during the first half of 1943—even if at times the accomplishment was like that of a stubborn rear-guard—to secure our essential professional activities until the early months of 1944, when the sharp alteration of policy by the Selective Service System introduced a state of affairs with which most of those present are better acquainted than I am. The prevailing principles of Selective Service leave us very little room for present helpful activities, though there are few of us who fail to realize that those principles, if long maintained in operation, threaten the destruction of our supply of young scientists and technicians. It may therefore be anticipated that the current inactivity of the War Policy Committee in respect to draft problems will presently give way to renewed concern and renewed activity.

A problem which is, so far as the scientific professions are concerned, inseparable from the whole fundamental concept of Selective Service is that of the assignment of selectees to duty within the Armed Services after induction. It is certainly of the utmost importance for the national security that the training of the scientist should not be lost by virtue of his induction and subsequent assignment. In the case of doctors and medical scientists, the organization of both Army and Navy eliminates their diversion to other than medical service and thus insures against the waste of their professional preparation. In the case of other scientists, equally essential to the proper functioning of a modern military organization, this is not the case. Indeed, examples of vital needs for scientific personnel which remained unfilled while qualified scientists were occupied in the non-scientific non-technical duties of some earlier assignment are all too common. It is quite clear that the military services need to develop a flexible and accurate mechanism for segregating scientific personnel and reserving it for the technical requirements of the organization. I have no doubt that the Army and the Navy, on the basis of the lessons of this war, will find their own solutions for this problem. However, it remains a fact that during this war the problem has not been satisfactorily solved so far as scientific or other rare skills are concerned. I mention this matter in emphatic terms because it explains in part the resolution and firmness with which we have insisted in all our dealings with the Washington authorities that the mathematician employed in essential teaching or in essential war research, and also the student of mathematics preparing himself for such essential employment, should be given the greatest consideration for individual deferment under appropriate directives.

At the present time the War Policy Committee is working largely toward the future. It is plain that we shall meet many new and altogether different problems, some of which we can already recognize while others can still hardly be guessed.

To-night, however, my theme has been historical and I do not propose to venture into the realm of the future. At the historical level it has not been possible for me to give more than a rapid sketch of events, as I have seen them. You will all realize, I am sure, that a completely adequate account of these matters is not possible at the present stage. I hope you will agree with me that a thorough and painstaking history of this war period of American mathematics can and must be written when the time is ripe. With this thought in mind, I have taken the preliminary steps towards setting up a committee of the society to undertake this important task. We shall all await the fruits of its labors with the deepest interest—and also, of course, with patience.

MALARIA AND THE WAR[1]

By Lieutenant Colonel O. R. McCOY, M.C.,

DIRECTOR, TROPICAL DISEASE CONTROL DIVISION OF PREVENTIVE MEDICINE SERVICE, OFFICE OF THE SURGEON GENERAL[2]

NEVER before have millions of men engaged in tropical warfare. Disease prevention, always a major factor in military operations, now must include protection from all maladies that thrive in warm climates. Of these, malaria is by far the most important.

The military prowess of malaria has been demonstrated in other wars, but never before has this great disease predator had such an unsurpassed opportunity to exert its influence on the armies of many

[1] Presented at the symposium on "Parasitology in Relation to the War," held at the meeting of the American Association for the Advancement of Science in Cleveland, Ohio, September 12, 1944.

[2] On leave from the School of Medicine and Dentistry, University of Rochester, Rochester, N. Y.

nations. In some sectors malarial parasites have caused far more casualties than enemy bombs and bullets. To-day large numbers of Japanese soldiers are "withering on the vine" weakened by malnutrition and rendered non-effective by malaria and other tropical scourges.

The Army first felt the impact of malaria during the defense of Bataan. On-the-spot observers estimate that more than half of the men were weakened by malaria at the time of the surrender. Malaria casualties made costly the early attempts to regain the Solomons and New Guinea. At one time several allied divisions were out of action because of repeated malaria relapses, and patients with the disease occupied 40 per cent. of the hospital beds. Lessons learned from these experiences have had beneficial effect on later campaigns. Great strides have been made in the prevention of malaria in military forces. These accomplishments will stand us in good stead, for highly malarious regions stand between our present positions and the Japanese homeland.

At war's beginning malaria upheld an unsavory reputation as the world's greatest disease scourge; this in spite of the fact that effective methods of prevention had been known for four decades. In some places, our own southern states, for example, malaria was on the decline, but in the great tropical belt little progress in control had been achieved.

Will the war alter the world picture of malaria? Will the movement of armies, the disturbance of civilian populations and the intercontinental flight of hordes of airplanes spread the disease and increase its ravages? Or will scientific discoveries made under pressure of war provide better weapons for world-wide control? Observations of the war to date tempt one to speculate on the answers to these questions, particularly in relation to the malaria situation in our own country.

Drugs for the Prevention and Treatment of Malaria

Cinchona bark with its alkaloid, quinine, has been renowned as a specific for malaria for several centuries. Researches started in Germany during the last world war culminated fifteen years later in the invention of atabrine, a drug soon proved equal to quinine. Although employed in this country as early as 1932, atabrine at the start of the war was not well known to the American public or even among physicians. Quinine remained the commonly used remedy. The loss of the principal sources of cinchona bark to the Japanese with the fall of Java in March, 1942, abruptly altered the situation. Quinine supplies were limited to accumulated stockpiles, and atabrine had to be used to meet the urgent military demand for anti-malarial drugs. This enforced shift has not in any way been a military handicap. Army experience, backed by civilian studies, has shown that atabrine is in many ways preferable to quinine and just as free from undesirable effects. If unlimited supplies of quinine were now available, atabrine would remain the drug of choice for most military uses.

Neither quinine nor atabrine is an ideal anti-malarial, although either one employed in proper dosage promptly controls symptoms. Neither drug is a true causal prophylactic—that is, will destroy sporozoites and prevent mosquito-borne infection. Treatment with quinine or atabrine does not completely cure malaria caused by *Plasmodium vivax*. Relapses may occur regardless of dosage employed.

The search for a better anti-malarial than quinine or atabrine has been the subject of intensive effort beginning more than a year before the attack on Pearl Harbor. The Subcommittee on Tropical Diseases, formed by the National Research Council at the request of the Surgeon General, initiated a program which has included the synthesis of new drugs and the systematic testing of more than 8,000 compounds. These investigations have been conducted in civilian laboratories under projects approved by the Council of Medical Research and financed by the Office of Scientific Research and Development. Hundreds of scientists have contributed to this enterprise and many hundred thousands of dollars have been spent. Anti-malarial activity of some degree has been found in many groups of chemical substances heretofore not known to possess such properties. The ideal anti-malarial has not yet been found, but promising leads toward better drugs have been uncovered.

As a result of the intensive studies under the National Research Council program, better understanding of the action and effective use of the drugs now available for chemotherapy of malaria has been achieved. Through the work of Shannon and his associates it has been learned that atabrine must be given in relatively large initial doses in order to attain plasma concentrations sufficient to produce prompt clinical response. When administered in this manner atabrine equals the quick action of quinine when the drugs are given by mouth. Atabrine injected intramuscularly produces a high plasma concentration within a few minutes. Sufficient evidence, however, is not available to decide the relative effectiveness of atabrine administered intramuscularly as compared with quinine given intravenously for the treatment of cerebral malaria.

Allied armies have gained tremendous experience in the use of atabrine in the suppressive treatment of malaria. Thousands of men have been given small doses of atabrine regularly for many months to hold

in check malarial infection which otherwise would incapacitate them. Much has been learned regarding the most effective methods of administration for this purpose. Dosages totaling 0.7 gram per week, almost twice the amount recommended before the war, are now commonly employed. No evidence has been obtained that long-continued usage in such doses causes any ill effect. The observation that suppressive (so-called chemoprophylactic) treatment will not prevent mosquito-borne infection with vivax malaria has been abundantly confirmed. Attacks of vivax malaria experienced after suppressive medication is discontinued have constituted the major portion of the Army's malaria problem.

On the other hand, the demonstration of the effectiveness of atabrine in preventing development of falciparum malaria has been an important finding in the experience gained since the start of the war. When atabrine is administered in proper dosage before, during and after exposure to falciparum infection, later appearance of symptoms is consistently prevented. Falciparum malaria, better known as malignant tertian or tropical malaria, has caused far less trouble than was anticipated. High standards of Army medical care have kept the death rate from this virulent form of malaria at an amazingly low figure.

The discussion of drugs can not be concluded without mentioning the important work of Drs. Woodward and Doering in accomplishing the synthesis of quinine. So far, only minute amounts of the drug have been produced, but the possibility of eventual large-scale synthetic production is opened up. Although new substances related to quinine may be discovered which possess greater anti-malarial activity, the synthesis of quinine by itself is not an answer to the Army's malaria problem. Atabrine is already available and is generally preferable. What is most urgently needed is a new drug which will prevent or effect a permanent cure of vivax malaria. The primary goal of the present research program is to discover such an agent.

MEASURES FOR CONTROL OF MALARIA

Control of malaria depends fundamentally on the prevention of bites by infected anopheline mosquitoes. A variety of means may be employed to attain this end. Draining, filling or larviciding of mosquito breeding places, screening of buildings and spraying of insecticides are among the procedures most widely used. The success of the Army in preventing malaria at base installations has been achieved chiefly by thorough and widespread application of these proven measures.

At the beginning of mobilization it was feared that rapid expansion of the Army might cause increase in malaria among troops in this country, since the majority were to undergo training in southern states where malaria was still endemic. The Army strengthened mosquito control at military installations and made arrangement for the U. S. Public Health Service to conduct control measures in a mile-wide zone surrounding the reservations. This huge program has continued for three years, and about 10 million dollars have been spent. Malaria rates have not only remained less than those for peacetime years, but in 1943 decreased to the record low of only 0.2 per 1,000 for troops stationed in the continental United States. Thus, mosquito control has effectively prevented malaria from becoming a threat to the Army in this country.

Prevention of malaria among troops in the field is much more difficult. Time, effort and adequate supplies are required to achieve mosquito control in newly occupied territory. Malaria survey and control units, commanded by specially trained parasitologists, entomologists and sanitary engineers, have accomplished remarkable feats in eliminating mosquito hazards at base staging areas overseas and in many places have extended their work into battle zones. Troops in combat, however, must rely chiefly on personal protective measures to prevent infection. The use of atabrine to suppress symptoms has already been discussed. Protective clothing, use of nets, repellents and insecticidal sprays are measures that the individual soldier must himself apply to prevent bites by infected mosquitoes. Education of all ranks and branches of the Army in the importance of malaria has been carried out by special training programs, lectures, moving picture films, posters and booklets. Unit discipline in the enforcement of individual preventive measures has proved to be the most important factor influencing malaria rates in front-line troops.

Before the war began a coordinated research program under the auspices of the National Research Council, financed by the Office of Scientific Research and Development, through the Committee for Medical Research, was undertaken at the request of the Surgeon General to develop better insecticides and repellents. The bulk of this investigation has been carried on by the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture working in cooperation with various other agencies. New insect repellents have been developed which, applied to the skin, retain their effect for several hours and are far better than any available to the Army before the war. They are efficient not only against mosquitoes, but also against mites, sandflies and other insect disease vectors. Another important wartime advance has been the development of the aerosol insecticide

dispenser, more familiarly known as the "mosquito bomb." This handy one-pound device contains enough pyrethrum insecticide to kill mosquitoes in 150,000 cubic feet of space. Pressure from the inert gas freon discharges the insecticide in very small particles in the form of an aerosol which remains in the air for several hours. It is thus much more efficient than previously used flit-guns and is a weapon against insects that can easily be transported into forward areas.

The most outstanding advance in insect control during this war has been the discovery of the remarkable insecticidal properties of DDT—an abbreviation for the chemical compound, dichloro-diphenyl-trichloroethane. This substance, first used by the Army as a louse powder in typhus control, is also highly valuable as a mosquito larvicide and as an insecticide to kill adult mosquitoes. In recent months production of DDT has increased sufficiently so that large quantities are now available to the armed forces for mosquito control. DDT must not be regarded as a miraculous agent which will suddenly do away with the malaria problem, as some extravagant press reports have suggested. It does, however, offer promise of revolutionary methods of control which ought eventually to improve the malaria situation even in hyperendemic and poverty-stricken regions.

Full knowledge of the applications of DDT in malaria control is not yet attained. DDT is more toxic to mosquito larvae than any substance heretofore known. Consequently, it can be used in small amounts with resultant saving of time and effort in larviciding operations. The application for malaria control which is most promising, however, is its use in spraying the habitations of native carriers. When DDT in kerosene solution is sprayed on interior surfaces a residue is left which will kill insects lighting on the treated areas for several months. Since the destruction of infected adult mosquitoes constitutes the most effective break in the chain of transmission of malaria, this usage, with its long lasting effect, offers great promise for control of the disease in many tropical regions where it has been a principal cause of poor health and poverty. The world-wide postwar picture of malaria will be greatly changed by the advent of DDT.

Influence of the War on the Spread of Malaria

Disturbed conditions of war tend to favor the spread of infectious diseases. A double opportunity exists for increased dissemination of malaria. Many men infected overseas will harbor latent infections when they return to their homes, thus making possible the introduction of the disease into regions now malaria-free. A more important hazard, however, is the possible spread of dangerous mosquito vectors, such as *Anopheles gambiae,* into new areas.

The disastrous results which followed the introduction of *Anopheles gambiae* from Africa into Brazil a decade ago are well known. A vigorous campaign conducted by the Brazilian Government aided by the Rockefeller Foundation eliminated this menace to the health of the western hemisphere in 1940, but three years of effort and the expenditure of some millions of dollars were required before success was achieved. Strict enforcement of regulations regarding insecticidal spraying of aircraft have thus far prevented reintroduction of *gambiae* from Africa, although the volume of travel has increased a thousand fold.

Recent reports, however, indicate a threatening spread of *Anopheles gambiae* on the continent of Africa. While formerly confined to the upper Nile, this species in the last few years has extended its range down river into middle Egypt. The role of increased war travel in this spread is not clear, but it appears to be a contributing factor. Alarming epidemics of malaria have already occurred in this new *gambiae* territory, and potential calamity threatens the populous region of the lower Nile delta. The Rockefeller Foundation is again lending its resources and experience in a renewed battle against spread of this dangerous malaria vector.

Wartime activities change the malaria picture in parts of the Pacific. For example, clearing of jungle undergrowth at base areas in New Guinea has favored the propagation of *Anopheles punctulatus,* which prefers sunlight in its breeding places. Shell holes, bomb craters and road ruts create other new breeding places. Most of these man-made influences on the malaria situation will, of course, gradually disappear as the armies move on. A hazard of greater importance is the possible introduction of anophelines into Pacific islands now free from malaria. Hawaii, Samoa, Fiji and other island groups in the central Pacific have never suffered from malaria because anopheline mosquitoes to transmit the disease are not indigenous. Introduction of a potent vector in these places would be a disaster. Unceasing vigilance is necessary everywhere to prevent spread of insect disease vectors by aircraft. A commission composed of representatives of the Army, Navy and the U. S. Public Health Service has been investigating the new hazards of disease introduction resulting from modern advances in transportation. Quarantine regulations will be strengthened where indicated.

The possible spread of malaria in this country by returned soldiers has caused public concern. However, the possible introduction of anopheline species which are efficient carriers of malaria is potentially

more dangerous. The efficiency and abundance of mosquito vectors have greater influence on the prevalence of malaria than changes in the status of the human reservoir. The hazard of the establishment of foci of malaria in places now free from the disease is real and can not be overlooked. Chief efforts of public health authorities should be directed toward the elimination of anopheline mosquitoes. Attempts to regulate the location and movement of possible carriers of malaria meet many practical difficulties and offer slight hope of producing fruitful results.

Members of the armed forces who have had malaria overseas will receive adequate treatment before discharge. It is true that many may still harbor latent infection and may suffer a relapse at a later date. At present no drug is known which will completely eliminate the parasite and no means are available to detect those who may continue to harbor a latent infection. Many individuals suffer only a single attack of malaria, and among those who relapse the chance of subsequent attacks continually decreases. It appears safe to estimate that probably 80 per cent. of men in the services who have had malaria will be entirely free from the disease at the time they are discharged. To attempt follow-up of servicemen merely on the basis of a history of having had malaria would result in much wasted effort.

A concerted campaign against *Anopheles quadrimaculatus,* the only important malaria vector in the United States, is the most feasible and effective effort that can be made in this country. Such a program is already planned by the U. S. Public Health Service. Cooperative mosquito control projects by state and local agencies will contribute greatly to reduction of our malaria problem. Not only will chance of the establishment of new foci be lessened but, more important, the control of the disease will be strengthened in areas where it is now endemic. Improved diagnosis and reporting of malaria, especially in states where it does not now exist, will enable prompt recognition of outbreaks and immediate institution of mosquito control measures. If proper measures are employed, extension of malaria in this country should not occur as a result of the war. During the past few years malaria has decreased to the lowest level ever recorded, both in the military and civilian populations. With properly directed efforts in mosquito control this decline should be maintained, and it is reasonable to hope that malaria may some day be completely eradicated from the United States.

The war has given tremendous impetus to the study of malaria, to the search for new drugs and to the development of improved methods of control. The gains from wartime advances in knowledge of malaria and its prevention appear to far outweigh the adverse effects of the war in spreading the disease and its vectors. Our armies are demonstrating that white men can invade the tropics and conquer malaria. The world can look optimistically toward more effective malaria control in the postwar years.

OBITUARY

MAURICE COLE TANQUARY

MAURICE COLE TANQUARY, professor of entomology (apiculture) in the Department of Agriculture of the University of Minnesota, St. Paul, died in the University Hospital on October 25, after an illness of over a month.

Professor Tanquary was born on November 26, 1881, and was reared on a farm near Lawrenceville, Ill. As a young man he taught in public schools and began his college work at Vincennes University. Transferring to the University of Illinois, he received the A.B. degree in 1907. He continued as a graduate student and as assistant in zoology and entomology at the University of Illinois, receiving his M.A. in 1908 and his Ph.D. in 1912.

On completion of his doctorate he was appointed instructor in entomology in the Kansas State College of Agriculture but in 1913 was given leave of absence to join the Crocker Land Expedition as zoologist. Returning from the Arctic in 1916 he was advanced to an assistant professorship at Kansas State College and to associate rank in 1919.

Later in 1919 Professor Tanquary was made state entomologist of Texas and chief of the division of entomology in the College of Agriculture and Mechanic Arts, holding these positions until 1924. In 1928 he was appointed professor of entomology at the University of Minnesota.

In early life he became much interested in the habits of insects. His first published paper reported experiments on the adoption of *Lasius, Formica* and *Polyergus* queens by colonies of alien species. His doctorate thesis, published in 1913 in the *Bulletin* of the Illinois State Laboratory of Natural History, was entitled "Biological and Embryological Studies on Formicidae." It was natural that as he advanced in economic entomology, he devoted more and more attention to the problems of beekeeping and of honey production.

The result was a determination to devote himself to this field. He resigned his position in Texas in 1924 and established in North Dakota a large commercial apiary, where he continued his studies on the habits of bees and bee management unhampered by other

routine. When he came to the University of Minnesota in 1928, it was with the understanding that he continue the management of this apiary, which was transferred to northern Minnesota. In it as in the college apiary, there were constantly underway studies on the overwintering of bees, the utilization of package bees, diseases of bees and other studies of remote as well as of immediate practical application. Over the years he was a persistent investigator of methods of controlled mating of the honeybee and had obtained promising results in this much worked field.

Professor Tanquary was an excellent teacher, who took a personal interest in his students and was never too busy to give them assistance in their problems. His willingness to carry his share of the load under the present abnormal conditions was well illustrated by the manner in which he cheerfully took over the teaching of biology in the School of Agriculture and the personal attention he gave the students. He was widely recognized as a man with a broad scientific grounding in entomology and exceptional ability to apply it in a practical manner. While his formal publications were few he was a regular contributor to bee journals, and carried on a very extensive correspondence of an advisory nature with both amateur and commercial beekeepers.

He was a friendly man. We found him, as did Macmillan under trying Arctic conditions, "even tempered, never got excited, was always in good humor." He will be missed sorely by his colleagues of years and by the many students and practical beekeepers who found him always ready to aid them in their problems.

WILLIAM A. RILEY

RECENT DEATHS

DR. FREDERICK SLOCUM, professor of astronomy and director of the Van Vleck Observatory of Wesleyan University, died on December 4 in his seventy-third year.

DR. ALONZO JOHN HAMMOND, consulting engineer of Chicago, Ill., died on December 1 at the age of seventy-five years.

DR. JANE BURNS HERSHEY, supervisor of bacteriology of the Laboratory Section of the St. Louis Health Division, died on November 5 at the age of thirty-one years.

IN the obituary appreciation of Albert Kingsbury in the issue of SCIENCE for December 1, the date of his death is given as July 28, 1944. It should be July 28, 1943.

SCIENTIFIC EVENTS

THE VISIT OF INDIAN SCIENTIFIC MEN

THE following Indian scientific men are visiting the United States on a mission to develop scientific and cultural contacts between India and this country. A special press conference was held at the Government of India Information Services in Washington on December 11. Members of the delegation are:

Dr. Nazir Ahmad, director of the Technological Laboratory of the Indian Central Cotton Committee.

Colonel S. L. Bhatia, deputy director general of the Indian Medical Service.

Sir Shanti Swarup Bhatnagar, Kt., O.B.E., director of the Scientific and Industrial Research Directorate of the Government of India.

Sir Jnan Chandra Ghosh, Kt., director of the Indian Institute of Science, Bangalore, and president of the National Institute of Sciences of India.

Professor S. K. Mitra, Ghose professor of physics, University of Calcutta.

Professor Meghand Saha, F.R.S., Palit professor of physics, University of Calcutta.

Professor J. N. Mukherji, O.B.E., professor of chemistry, University College of Science, Calcutta.

THE ANNUAL MEETING OF THE AMERICAN MATHEMATICAL SOCIETY

THE fifty-first annual meeting of the American Mathematical Society was held at the Museum of Science and Industry, Chicago, on November 24 and 25, in conjunction with the annual meeting of the Mathematical Association of America. The registration exceeded two hundred, including one hundred and seventy-seven members of the society.

The eighteenth Josiah Willard Gibbs Lecture was given on Friday evening, November 24, by Professor John von Neumann, of Princeton University. His subject was, "The Ergodic Theorem and Statistical Mechanics." The attendance at this lecture was about three hundred.

On Saturday afternoon, November 25, Professor Will Feller, of Brown University, gave an address entitled, "Limit Theorems in the Theory of Probability."

Thirty-eight contributed papers on research problems were presented, sixteen in person and twenty-two by title.

Resolutions on the death of the distinguished mathematician, Professor George D. Birkhoff, were adopted. These will be published in the January issue of the *Bulletin* of the American Mathematical Society.

The following officers were elected for terms of two years each: *President,* T. H. Hildebrandt; *Vice-president,* J. M. Thomas; *Secretary,* J. R. Kline; *Associate Secretary,* T. R. Hollcroft; *Treasurer,* B. P. Gill; *Librarian,* Arnold Dresden; *Members of Editorial*

Committees, Bulletin, Saunders MacLane and E. B. Stouffer; *Transactions,* Oscar Zariski; *Colloquium Publications,* C. C. MacDuffee; *Mathematical Reviews,* Oswald Veblen; *Mathematical Surveys,* A. A. Albert, Nelson Dunford, J. D. Tamarkin; *American Journal of Mathematics,* Richard Brauer; *Members-at-large of the Council,* H. F. Bohnenblust, S. S. Cairns, H. B. Curry, M. H. Ingraham, I. S. Sokolnikoff; *Board of Trustees,* W. R. Longley, Marston Morse, G. W. Mullins, R. G. D. Richardson and Warren Weaver.

The council voted to hold the 1945 summer meeting of the society at Macdonald College, McGill University, Montreal, June 24–25, 1945, at the conclusion of the Canadian Mathematical Congress.

T. R. HOLLCROFT,
Associate Secretary

GRANTS OF THE CARNEGIE CORPORATION

A GRANT of $5,000,000 by the Carnegie Corporation of New York to increase the endowment of the Carnegie Institution of Washington was announced in the 1944 annual report of the president of the corporation, the late Walter A. Jessup. President Jessup, it will be recalled, died in July, 1944, but had previously finished the writing of his annual report. The large gift to the institution was the largest grant of the year, and serves to make the institution probably the most heavily endowed scientific research agency in the United States, if not in the world. Its endowment now amounts to some $32,000,000, two thirds of which came from gifts by Mr. Carnegie and the remainder primarily from the corporation.

Other grants amounting to $890,000 were made to various agencies including national emergency organizations such as the American Red Cross, $225,000 for war service activities; and the National War Fund, $150,000 to help to support the war work of its constituent agencies.

The corporation also voted various amounts to organizations working in the field of foreign affairs such as the Carnegie Endowment for International Peace, $75,000, for its work in the United States; the Council on Foreign Relations, $40,000; the Institute of Pacific Relations, $34,000; and the Foreign Policy Association, $10,000.

Colleges and universities for the past few years have been preoccupied with emergency projects and accordingly did not receive so large or so numerous gifts as in other years. Included in the list of academic recipients are the Polytechnic Institute of Puerto Rico, which in recent years has shown marked educational progress in that island, receiving $20,000; the Johns Hopkins University, $12,000; Princeton University, the School of Public and International Affairs, $10,000; and the University of Rochester, $10,000.

President Jessup, commenting on the decrease in sums granted to colleges and universities by the corporation during the past two decades, said that in 1912 when the corporation first began to make grants, roughly $6,000,000 was appropriated each year, representing a sum equal to one fifteenth of the annual income of institutions of higher education in America at that time. The scale of expenditure in American colleges has increased at such a rate that now the total amount of the grants, if all were expended in this field, would be one one hundred and fortieth of the total receipts of the colleges.

AWARD OF THE WILLIAM H. NICHOLS MEDAL

PROFESSOR VINCENT DU VIGNEAUD, head of the department of biochemistry of the Cornell University Medical College, has been awarded the William H. Nichols Medal of the New York Section of the American Chemical Society in recognition of his researches on biotin. His discovery of the chemical architecture of biotin was announced at a meeting of the section on October 9, 1942. In 1943 the synthesis of biotin was achieved in the laboratories of Merck and Company.

The award also recognizes Professor du Vigneaud's researches on transmethylation, the mechanism of the conversion of methionine to cystine, the use of isotopes in certain problems in intermediary metabolism and researches on the chemistry of insulin, on the posterior pituitary hormones, on glutathione and on carnosine.

Previous recipients of the medal were John M. Nelson, Phoebus A. Levene, Joel H. Hildebrand, Irving Langmuir, James Bryant Conant, Frank C. Whitmore, William M. Clark, Charles A. Kraus, Hugh S. Taylor, Julius A. Nieuwland, Gilbert N. Lewis, Charles L. Parsons, Claude S. Hudson, Marston T. Bogert, Henry C. Sherman, Roger Adams, William A. Noyes, Thomas Midgley, Samuel C. Lind, Leo H. Baekeland, H. C. P. Weber, Edward C. Franklin, M. A. Rosanoff, C. W. Easley, T. B. Johnson, Charles James, M. H. Walker, M. B. Bishop, E. B. Voorhees, William L. Evans, Moses Gomberg, Samuel E. Sheppard, John A. Wilson, Linus Pauling, Duncan A. MacInnes, Arthur B. Lamb and Carl Shipp Marvel.

The Nichols Medal award was founded by the late Dr. William H. Nichols, a charter member of the American Chemical Society, chairman of the board of the Allied Chemical and Dye Corporation. It is conferred annually to stimulate original research in chemistry. The presentation will be made at a meeting of the New York Section and of the Society of Chemical Industry at the Hotel Pennsylvania on March 9, 1945.

PRESIDENT ROOSEVELT'S LETTER ON THE OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT

THE President has written the following letter to Dr. Vannevar Bush, Office of Scientific Research and Development:

Dear Dr. Bush:

The Office of Scientific Research and Development, of which you are the Director, represents a unique experiment of team-work and cooperation in coordinating scientific research and in applying existing scientific knowledge to the solution of the technical problems paramount in war. Its work has been conducted in the utmost secrecy and carried on without public recognition of any kind; but its tangible results can be found in the communiques coming in from the battle-fronts all over the world. Some day the full story of its achievements can be told.

There is, however, no reason why the lessons to be found in this experiment can not be profitably employed in times of peace. The information, the techniques, and the research experience developed by the Office of Scientific Research and Development and by the thousands of scientists in the universities and in private industry, should be used in the days of peace ahead for the improvement of the national health, the creation of new enterprises bringing new jobs, and the betterment of the national standard of living.

It is with that objective in mind that I would like to have your recommendations on the following four major points:

First: What can be done, consistent with military security, and with the prior approval of the military authorities, to make known to the world as soon as possible the contributions which have been made during our war effort to scientific knowledge?

The diffusion of such knowledge should help us stimulate new enterprises, provide jobs for our returning servicemen and other workers, and make possible great strides for the improvement of the national well-being.

Second: With particular reference to the war of science against disease, what can be done now to organize a program for continuing in the future the work which has been done in medicine and related sciences?

The fact that the annual deaths in this country from one or two diseases alone are far in excess of the total number of lives lost by us in battle during this war should make us conscious of the duty we owe future generations.

Third: What can the Government do now and in the future to aid research activities by public and private organizations? The proper roles of public and of private research, and their interrelation, should be carefully considered.

Fourth: Can an effective program be proposed for discovering and developing scientific talent in American youth so that the continuing future of scientific research in this country may be assured on a level comparable to what has been done during the war?

New frontiers of the mind are before us, and if they are pioneered with the same vision, boldness, and drive with which we have waged this war we can create a fuller and more fruitful employment and a fuller and more fruitful life.

I hope that, after such consultation as you may deem advisable with your associates and others, you can let me have your considered judgment on these matters as soon as convenient—reporting on each when you are ready, rather than waiting for completion of your studies in all.

Very sincerely yours,

FRANKLIN D. ROOSEVELT

SCIENTIFIC NOTES AND NEWS

THE James Watt International Medal for 1945 has been awarded to Dr. F. W. Lanchester, F.R.S., consulting engineer, for his work on the development of the motor-car and the aeroplane. The medal is awarded by the council of the British Institution of Mechanical Engineers, with the collaboration of engineering institutions in some eighteen countries. He is the fourth recipient of the medal; the others were Henry Ford, Orville Wright and M. Michel.

THE Clough Memorial Medal of the Geological Society of Edinburgh for the year 1943–44 has been awarded to Dr. Murray Macgregor in recognition of his contributions to the geology of Scotland and in particular to the geology of the Scottish coalfields.

THE American Academy of Pediatrics presented at the St. Louis Wartime Conference on Child Health on November 3 the first annual Borden Award to Major Harry H. Gordon, M.C., assistant professor on leave, and Dr. Sam Z. Levine, professor of pediatrics at the Cornell University Medical College, in recognition of their work on "Metabolic Studies on Nutritional Requirements of Premature and Full Term Infants." The award consists of a bronze medal with the inscription "award for outstanding achievement in research in nutrition of infants and children" and a prize of $1,000.

A BANQUET was held on December 4 in honor of James Fisher, for forty-five years head of the depart-

ments of mathematics and physics of the Michigan College of Mining and Technology, who has been connected with the college since 1895. Tributes were paid by President Grover C. Dillman and members of the faculty and alumni. A number of congratulatory letters were read from alumni organizations, individual alumni, former colleagues and officers of national organizations. Dr. Fisher retains his connection with the college as head of the Extension Division.

SIR FREDERICK HANDLEY PAGE, the British aircraft constructor, has been elected an honorary fellow of the Institute of Aeronautical Sciences of America.

DR. WILLIAM WORTHINGTON HERRICK, professor of clinical medicine at the College of Physicians and Surgeons of Columbia University, has been elected president of the New York Academy of Medicine for a term of two years.

DR. H. SHIPLEY FRY, professor and head of the department of chemistry of the College of Liberal Arts of the University of Cincinnati, on account of ill health will resign on February 1 after nearly a half-century of university work. He will receive the honorary title of professor emeritus.

DR. WILLIAM OTIS HOTCHKISS, who recently resigned as president of the Rensselaer Polytechnic Institute at Troy, N. Y., will be succeeded by Livingston W. Houston, chairman of the Board of the Ludlow Valve Manufacturing Company.

JULIAN L. CULBERTSON, professor of chemistry at Washington State College, has been appointed visiting professor at Columbia University.

DR. J. P. QUIGLEY, formerly professor of gastro-intestinal physiology at the School of Medicine of Western Reserve University, has been appointed professor of pharmacology and chief of the division in the University of Tennessee at Memphis.

DR. ROBERT R. SEALOCK, assistant professor of physiological chemistry at the University of Rochester, has been appointed associate professor of chemistry at Iowa State College.

DR. FRANK GOLDBY, Elder professor of anatomy in the University of Adelaide, has been appointed professor of anatomy at St. Mary's Hospital Medical School, London.

THE retirement is announced of Professor H. Stanley Allen, professor of natural philosophy at the University of St. Andrews. He is succeeded by Dr. J. T. Randall, lecturer in the Cavendish Laboratory of the University of Cambridge.

DR. ROGER ADAMS, professor of organic chemistry and head of the department of chemistry of the University of Illinois, has been elected chairman of the board of directors of the American Chemical Society to succeed the late Thomas Midgley. Professor Adams is now on leave from the university for work with the National Defense Research Committee in Washington.

DR. WALTER LEWIS TREADWAY, medical director of the U. S. Public Health Service, has retired from active duty for disability incurred in service. Since July, 1941, he had been stationed in Los Angeles as medical officer in charge of public health service activities.

PHILIP LEVINE, research chemist at Mount Sinai Hospital under the Office of Scientific Research and Development, and at the Squibb Institute of Medical Research, has joined the research staff of the Apex Chemical Company at Elizabeth, N. J.

DR. KURT G. STERN, of the department of physiological chemistry at the Yale University School of Medicine, was awarded recently a grant available for use at any institution amounting to $19,000 for fundamental research on proteins and high polymers from the Carrie S. Scheuer Foundation of New York. He has selected the Polytechnic Institute of Brooklyn, N. Y., where he will work in cooperation with the research group of Dr. Herman F. Mark, professor of organic chemistry at the institute, where a new laboratory will be installed.

ELI LILLY AND COMPANY, Indianapolis, have made a gift of $15,000 to the University of Cincinnati for research in nutrition under the direction of Dr. Tom D. Spies, associate professor of medicine at the College of Medicine and director of the nutrition clinic at Hillman Hospital at Birmingham, Ala., where the work will be carried on.

AN anonymous gift of $5,000 has been made for the research on high blood pressure being carried out by Dr. Harry Goldblatt, professor of experimental pathology and associate director of the Institute of Pathology of Western Reserve University. This work has been supported chiefly by funds from the Commodore Louis P. Beaumont Foundation.

DR. CLARENCE T. VAN METER, assistant professor of chemistry and physics at the School of Pharmacy of the University of Pittsburgh, has become scientific director of the physiological laboratories of Reed and Carnrick, Jersey City, N. J.

DR. R. R. SPENCER, chief of the National Cancer Institute, Bethesda, Md., delivered on November 21 the annual Barnard Hospital Lecture of the St. Louis Medical Society. His subject was "Federal Cooperation in the Cancer Problem."

DR. MARK G. FOSTER, physicist at the Naval Ordnance Laboratory of Washington, D. C., on the evening of November 30 gave a lecture at Miami Univer-

sity under the auspices of Sigma Xi and Sigma Pi Sigma. The lecture was entitled "The Qualifications of a Research Physicist."

DR. HOMER L. DODGE, president of Norwich University, Northfield, Vt., on November 24 addressed the Sigma Xi Club of the University of Vermont on "The Impending Post-War Shortage of Scientists and Engineers."

THE Harben Lectures of the Royal Institute of Public Health and Hygiene were delivered on December 11, 12 and 13 by Sir Alexander Fleming, F.R.S. He spoke on "Penicillin—Its Discovery, Development and Uses in Medicine and Surgery."

A COMMEMORATION of the hundredth anniversary of the discovery of anesthesia was held in San Francisco on December 10 and 11. On Sunday there was a tree planting and the dedication of a memorial tablet in Golden Gate Park, and on Monday there were exercises at the College of Physicians and Surgeons. The speakers included Dr. Chauncey D. Leake, dean of the Medical School of the University of Texas, formerly professor of pharmacology at the University of California, and Dr. William B. Neff, associate clinical professor of surgery at the School of Medicine of Stanford University.

IT is reported in the *Journal* of the American Medical Association that the ninety-fifth annual session of the association will be held in Philadelphia from June 18 to 22. This session was originally scheduled to be held in New York from June 11 to 15, but because of untoward conditions growing out of the war emergency it was found that needed facilities would not be available in that city. Hotel reservations will be made through a central office in Philadelphia.

THE Sociedad Mexicana de Historia Natural (Mexico City) at its regular meeting, held on November 17, elected the following officers for the year 1945: *President,* Ing. Julio Riquelme Inda; *Vice-president,* Dr. Arthur C. Baker; *Treasurer,* Professor Gilberto Najera A.; *Assistant Treasurer,* Professor Raul Chavez Lopez; *Recording Secretary,* Professor Dionisio Pelaez. Professor Enrique Beltrán remains as permanent secretary of the society.

PLANS for the 1945 George Westinghouse Scholarship contest, open to senior high school boys in the United States, have been announced by the Westinghouse Electric and Manufacturing Company, sponsor of the awards. Ten scholarships, valued at $1,850 each, will be awarded for education in engineering at the Carnegie Institute in Pittsburgh. Applications for the scholarships will be accepted only until February 1, 1945. Students who competed in the 1944 competition are not eligible. The tests will be administered in all parts of the country by the College Entrance Examination Board on April 7. The ten awards will be made early in May. Successful contestants will begin work at the Carnegie Institute of Technology in June.

A GIFT of $100,000 in recognition of the need for better facilities for training in the profession of pharmacy has been made by the F. W. Fitch Company for the erection at Drake University of a modern, well-equipped Pharmacy Building, to be constructed as soon as possible after material and labor are available and building regulations permit.

THE late Oscar M. Stewart, from 1901 to 1944 professor of physics at the University of Missouri, bequeathed to the university the sum of $1,000, to be used, principal and interest, for some educational or scientific purpose connected with the department of physics. This fund may be used for undergraduate or graduate scholarships or fellowships for students majoring or minoring in the department of physics. In addition to this gift, Professor Stewart set up a trust fund of considerably larger amount to serve the same purposes as the $1,000 gift. Applications for assistance from these funds for the session 1945–46 should be made at an early date to the chairman of the department of physics.

THE William Volker Charities Fund, Inc., of Kansas City, Mo., has made a gift of $425,000 to underwrite a five-year research on citizenship education which is to be conducted in the public schools of Detroit. The object is to study ways of increasing "the interest, competence and participation of boys and girls in the activities of the good citizen."

THE School of Medicine of St. Louis University is planning a post-war building program which includes two science buildings to be erected at a cost of $250,000 each, one for the departments of physics and geophysics and the other for the departments of chemistry and biology.

THE United States Airlines has made a gift of $600 to the College of Education of Wayne University for ten scholarships of $50 each for a study relating to aviation.

Engineering and Industrial Chemistry reports that it is planned to establish a Vitamin Foundation to be incorporated as a non-profit organization to initiate and develop research, to aid in financial support of groups investigating vitamins and nutrition, to serve as an authoritative body in negotiations with scientific and medical groups and government agencies, to acquire and use patents and trade marks, and to recommend proper standards and terminology.

THE University of New Mexico and the Laboratory of Anthropology (Santa Fe) announce their joint

publication of a new *Southwestern Journal of Anthropology*, to appear early in 1945. Supplementing existing periodicals, this quarterly will provide additional space for articles in general anthropology. Contributions are invited by the editor, Dr. Leslie Spier, of the University of New Mexico.

A FIVE-VOLUME collection of photo-micrographs of more than a hundred meteorites, made by Stuart H. Perry, of Adrian, Mich., has been presented by him to the University of Michigan, where he conducted his work, to the Chicago Natural History Museum and to the U. S. National Museum. Three sets only have been made.

DISCUSSION

AMPHIPATHIC CHARACTER OF GELATIN SHOWN IN ITS ADSORPTION TO POLAR SURFACES

SOME experiments on the retention of gelatin by silver bromide made in these laboratories were described in 1932.[1] They were made with silver bromide grains centrifugally separated from a diluted silver bromide emulsion, and indicated that continued washing (at pH 6.5) brought down the retained gelatin to a limit after which no more was removed. The specific area of the grains was determined[2] and the thickness of gelatin estimated from experiments on film spreading.[3] From these measurements there was indicated a layer of the order of two molecules thick, *ca.* 16 Å. Further experiments, washing at higher temperature (boiling in water), reduced the value to one half. It was concluded that "a monomolecular layer was actually present, and that the rest of the gelatin was occluded in the grain, or . . . that a secondary layer is attached to the primary layer by weaker forces."

Recent experiments, using techniques developed in connection with the study of dye adsorption,[4] have enabled us to confirm the latter hypothesis, and to show that gelatin is primarily and irreversibly adsorbed, by polar groups, to silver halide as a monolayer, exposing nonpolar groups to the solution. As more gelatin is added to this, a second layer is built up, in which the nonpolar groups of the second layer adhere to—or cohere with—the nonpolar groups of the primary (priming) layer, while the polar hydrophile groups solvate and repeptize the first precipitate. This second layer—which is relatively reversible (Langmuir type of adsorption isotherm)—it is which confers on protein-covered silica—and other—particles the characteristic electric potential and charge of "adsorbed" protein, which is identical, therefore, with that of dissolved protein.[5] Whether molecularly stratified systems of still higher order can be built up[6] is still uncertain, though a reconsideration of some experimental work of A. H. Nietz,[7] of these laboratories, suggests that it may not be impossible. Concerning this and other aspects of the general problem of protein lamellae, fuller publication by the writer and colleagues is in preparation.

S. E. SHEPPARD

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[1] S. E. Sheppard, R. H. Lambert and R. L. Keenan, *Jour. Phys. Chem.*, 36: 174–184, 1932.

[2] By photomicrographic scanning, *cf.* A. P. H. Trivelli and R. P. Loveland, *Jour. Franklin Inst.*, 204: 193, 377, 1927.

[3] S. E. Sheppard and R. L. Keenan, *Nature*, 121: 982, 1928; S. E. Sheppard, A. H. Nietz and R. L. Keenan, "Supermolecular State of Polymerized Substances in Relation to Thin Films and Interfaces," *Ind. Eng. Chem.*, 21: 126, 1929.

[4] S. E. Sheppard, R. H. Lambert and R. D. Walker, *Jour. Chem. Phys.*, 7: 265, 1939.

EFFECT OF VITAMIN B_6 (PYRIDOXINE) IN THE TREATMENT OF LEUCOPENIA AND GRANULOCYTOPENIA OF TOXIC ORIGIN IN HUMANS. PRELIMINARY REPORT

AGRANULOCYTIC angina is a disease characterized by an acute febrile illness, necrotic and ulcerative lesions in the mouth and pharynx and an extreme reduction of the granulocytes in the blood. Granulocytopenia is pathognomonic of the disorder, although leucopenia is usually present as well. The disease is uncommon in the idiopathic form but occurs more often secondary to the administration of certain drugs such as amidopyrine, some barbiturates and dinitrophenol. Since the introduction of sulfonamides in the treatment of bacterial diseases, this complication has been noted more frequently. Within the past year, a similar hematologic catastrophe was described by Astwood[1] following the use of thiouracil for the treatment of hyperthyroidism. His findings have been amply confirmed. This hazard seriously interferes with and restricts the use of a large group of valuable therapeutic agents.

The accepted therapy relies on the use of blood transfusions and on pentose nucleotides. The result obtained by these means is often disappointing.

[5] H. A. Abramson, "Symposia on Quantitative Biology" (Cold Spring Harbor, N. Y.), I, 39 (1933).

[6] K. Blodgett and I. Langmuir, *Phys. Rev.*, 51: 964, 1937.

[7] A. H. Nietz: "Molecular Orientation at Surfaces of Solids, Pt. III. Monomolecular Films Measured by a Contact Angle Method," *cf. Ind. Eng. Chem.* (*News Edit.*), 6, No. 16, Aug. 20, 1928. Part III was presented at the 76th meeting of the American Chemical Society, September 10–14, 1928, but not published.

[1] E. B. Astwood, *Jour. Am. Med. Asn.*, 122: 78, 1943.

Sebrell and his associates[2] have shown that folic acid, a component of the vitamin B-complex, is effective in preventing and curing the neutropenia produced in rats by feeding the insoluble sulfonamides. It has been suggested[3] that this effect is an indirect one, in the sense that the folic acid fed is required by the coliform bacteria in the intestine for the production of some accessory substance which in turn produces the granulocytic response. Fouts *et al.*[4] observed that dogs with a dietary deficiency of vitamin B_6 develop a microcytic hypochromic anemia which is not relieved by iron. It is well known that the anemia of pellagra and pernicious anemia is similarly unresponsive to iron. Since pyridoxine is a constituent of liver and yeast, both of which are effective in these disorders, Vilter, Schiro and Spies[5] administered pyridoxine intravenously to three pellagrins and two patients with pernicious anemia in relapse. Improvement was noted within 48 hours, and although there was only a 5 per cent. reticulocyte response, there was a striking increase in the leucocyte count, especially in the granulocytic series. Goldman and Malvados[6] report somewhat similar observations in bone marrow studies on three cases of Cooley's anemia when pyridoxine was used in association with pregnancy urine hormone. These findings led us to attempt the treatment of leucopenia and granulocytopenia using intravenously administered pyridoxine hydrochloride.

The material used was a 10 per cent. solution of pyridoxine hydrochloride in physiological sodium chloride. Three cases of agranulocytic angina were studied. The precipitating factor in the first instance was 4.0 grams sulfathiazole given over a period of 24 hours. In the second instance there was no medication apart from self-administered aspirin. The third case followed the use of thiouracil and developed about two months after this therapy for hyperthyroidism was instituted. A total of 13.5 grams of the drug had been taken.

In the first instance noted, leucopenia and granulocytopenia persisted despite repeated blood transfusions and pentose nucleotide in large doses. The second case received one blood transfusion without apparent effect. The third case received only pyridoxine. Pyridoxine hydrochloride was administered in doses of from 125 mgm to 200 mgm intravenously daily. The temperature in each case fell to normal limits and symptoms disappeared within 48 hours. This was associated with a leucocyte increase and the reappearance of granulocytes in the blood. Therapy was continued for from five to six days and blood examinations performed for varying periods thereafter. The findings at two-day intervals for the first ten days after commencing pyridoxine therapy are recorded in Table 1. A full report is in preparation and will be published elsewhere.

TABLE 1

Days after first dose of pyridoxine HCl	Case 1		Case 2		Case 3	
	W.B.C.	Gran. Per cent.	W.B.C.	Gran. Per cent.	W.B.C.	Gran. Per cent.
0	2,850	0	6,400	0	4,300	6
2	8,050	44	7,050	8	5,400	30
4	19,150	67	10,900	27	8,400	53
6	23,750	43	21,300	61	7,750	68
8	28,500	59	29,300	61	7,800	75
10	27,900	64	18,000	78	9,100	66

Our results suggest that pyridoxine hydrochloride administered intravenously is a useful agent for the treatment of agranulocytic angina of toxic origin. Its effectiveness in three instances arising as a result of toxicity due to three chemically unrelated drugs suggests that pyridoxine acts by direct stimulation of the myelocytic elements of the bone marrow.

Max. M. Cantor
John W. Scott
Departments of Biochemistry and Medicine,
University of Alberta

[2] S. S. Spicer, F. S. Daft, W. H. Sebrell and L. L. Ashburn, *Public Health Reports*, 57: 1559, 1942; F. S. Daft and W. H. Sebrell, *ibid.*, 58: 1542, 1943.

[3] Leading article, *Nut. Rev.*, 2: 103, 1944.

[4] P. J. Fouts, O. M. Helmer and S. Lepkovsky and T. H. Jukes, *Jour. Nutrition*, 16: 197, 1938.

[5] R. W. Vilter, H. S. Schiro and T. D. Spies, *Nature*, 145: 388, 1940.

[6] L. M. Goldman and A. Malvados, *Jour. Clin. Endocrin.*, 1: 945, 1941.

SUMMER UPWELLING—NORTHEAST COAST OF FLORIDA

Daily surface water temperatures, taken for a number of years in connection with sea-level studies at U. S. Coast and Geodetic Survey primary tide stations, disclose an interesting anomaly in summer temperatures along the Florida northeast coast in the vicinity of Daytona Beach.

Southerly winds prevail in July and August, causing an offshore transport of surface water which is replaced by the colder subsurface waters of the Florida Current, the western edge of which is 25 nautical miles from shore at this latitude. That the water area thus cooled is comparatively extensive is indicated by the displacement of the air temperature-latitude curves for the months of July and August. By September the prevailing wind is northeast and the temperature of both surface water and air returns to normal for the latitude.

The full line curves in Fig. 1 show the mean monthly surface water temperatures for July, August and September, and are based on observations at Charleston, Savannah, Daytona, Miami and Key West. The light symbol shows the mean monthly surface water temperatures as observed at Diamond Shoal Light-

ship. The broken line curves are the mean monthly air temperatures for the 20-year period, 1923 to 1942, based on observations at 17 well-distributed U. S. Weather Bureau stations on the coast. Arrows give the prevailing wind directions as derived from the Pilot Charts issued by the U. S. Hydrographic Office.

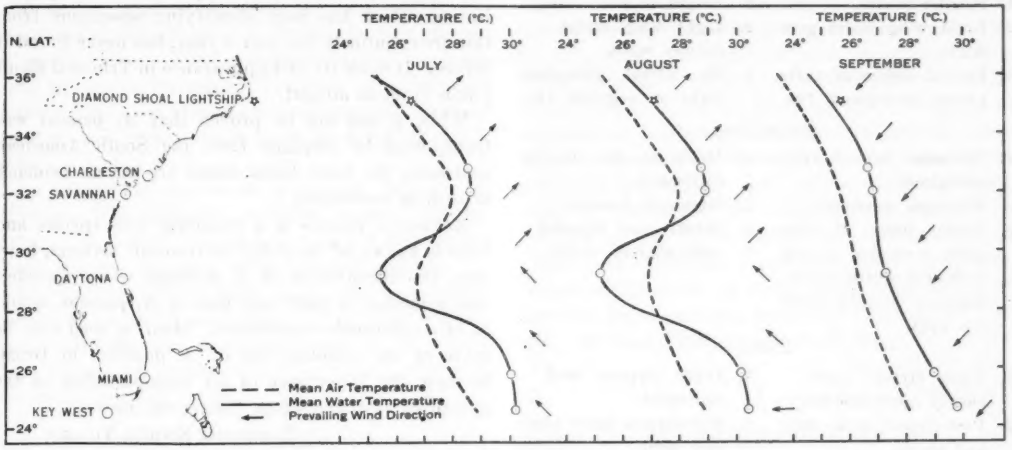

FIG. 1. Relation of water and air temperatures to prevailing direction of wind, southeastern coast of the United States.

A detailed investigation, including relations with annual changes in coastal currents, sea level and density, is contemplated after the war.

C. K. GREEN

U. S. COAST AND GEODETIC SURVEY

TRANSLITERATION OF RUSSIAN NAMES

FROM his recent letter in SCIENCE[1] it would appear that Dr. Kosolapoff has misunderstood the purport of my note,[2] in which it was suggested that, since the Russian Academy of Sciences has already devised a method of transliteration of Russian names, it would be advisable for all countries to comply with it, irrespective of whether or not this standard transliteration conforms phonetically to the letters of any particular language. Russian words transcribed according to this method should therefore be treated in the same way as words written in any other language using the Latin alphabet, without attempting to adapt their spelling to the phonetics of the user's language.

The question of phonetics is quite independent of transliteration and, therefore, irrelevant to the point under discussion. It concerns only students of languages but not readers who merely desire to substitute Russian characters by some universally recognized Latin equivalents. While such students might use some method of adaptation of Russian sounds to their own language, persons of the latter category could not do better than employ the standard method authorized and used by the Russian Academy, as outlined in my previous note.

For the phonetic representation of Russian letters, it would be preferable to use the script of the International Phonetic Association, which is of universal application, and not the system employed by the *Chemical Abstracts*, as advocated by Dr. Kosolapoff. The latter has the disadvantage of being restricted to the English language, and, moreover, it is out of date, since it is based on the archaic Russian orthography which has been discarded a quarter of a century ago in favor of the orthography set forth in my previous note.

Incidentally, it would be interesting to know which system of transliteration is employed in Dr. Kosolapoff's note for Czech, which is rendered twice as "Chech." Since the first two and the last two letters have different sounds, it is difficult to understand why the same symbols have been employed in both cases.

C. A. HOARE

THE WELLCOME RESEARCH INSTITUTION,
LONDON, ENGLAND

[1] June 16, 1944, p. 491.
[2] SCIENCE, April 21, 1944, p. 321.

ON THE OCCURRENCE OF ANOPHELES PESSOAI IN TRINIDAD, B. W. I.

ON October 22, 1943, a routine collection of anopheline larvae was brought to the laboratory for identification. The larvae were not those of any anopheline species reported for Trinidad or the West Indies. Study of the imagines after emergence identified them as *Anopheles* (*Nyssorhynchus*) *pessôai* Galvão and Lane. Study of the male terminalia confirmed the identification. Adults and larvae have been found in varying numbers since that time.

This species is found in the northern part of South

America and previous to this has never been reported from the West Indies.

The following characteristics differentiate *A. pessôai* from our local *A. albitarsis*:

A. pessôai	*A. albitarsis*
ADULT FEMALE	
1. Smaller in size.	1. Larger in size.
2. Light wing scales pure white.	2. Light wing scales creamy white.
3. Lateral abdominal tufts present in segment two.	3. No lateral abdominal tufts on segment two.
ADULT MALE	
1. Mesosome more heavily chitinized.	1. Mesosome less heavily chitinized.
2. Mesosome narrower.	2. Mesosome broader.
3. Dorsal lobes of claspette truncated at tip with deep central notch; indented laterally below the apex.	3. Dorsal lobes rounded with shallow notch.
LARVA	
1. Inner clypeal hairs closely approximated.	1. Inner clypeals well separated.
2. Post-clypeal hairs long and single.	2. Post-clypeal hairs short and bifid.
3. Leaflets of inner hair of anterior submedian thoracic group with truncate tips.	3. Leaflets of inner hair of anterior submedian prothoracic group pointed.

Specimens of *Anopheles pessôai* from Trinidad have been deposited in the National Museum.

There is a strong indication that *Anopheles pessôai* was introduced to Trinidad by airplane. The following evidence is submitted. Previous reports from this area, notably that of Downs, Gillette and Shannon (1942–1943), did not list this species, and our organization, which has been identifying specimens from this area routinely for over a year, has never found it before. It made its first appearance in Trinidad about a mile from an airport.

While it can not be proven that *A. pessôai* was transported by airplane from the South American continent, the facts listed above are strong evidence of such an occurrence.

Anopheles pessôai is a relatively rare species and little is known of its ability to transmit malaria, however, the introduction of *A. darlingi*, whose distribution coincides in part with that of *A. pessôai*, would be of considerable significance. Mention need only be made of the establishment of *A. gambiae* in Brazil to show the importance of air transportation in the spread of new and often dangerous insects.

TAMARATH KNIGIN YOLLES
STANLEY F. YOLLES,
3d Lieutenant, Sn. C., AUS
DORWIN A. BYRD,
Sergeant, AUS

SCIENTIFIC BOOKS

HYPERTENSION

Hypertension and Hypertensive Disease. By W. GOLDRING and H. CHASIS. New York: The Commonwealth Fund. 1944. $3.50.

THE authors have made important contributions to the clinical study of hypertension and, more especially, with Homer Smith, to its renal functional aspects. This book is a monographic statement of their work, conclusions and impressions. It is not, as the title might imply, a comprehensive review of the topic, but rather fulfils admirably the authors' prefatory statement of intention. Its appeal and value will be greatest to those who have more than a passing acquaintance with vascular disease and who are especially interested in renal function.

One of the basic premises of the book is the view that experimental renal hypertension in animals is fundamentally different from essential hypertension in man. This view, which seems to ignore the greater probability of at least a partial similarity, is far from being generally accepted, and its adoption excludes much that is interesting and suggestive in the modern study of clinical hypertension. No better summary of the author's original studies of renal function in hypertension is available. Certain other chapters (Nos. 2, 6 and 8) are necessarily less complete. Thus, one wonders why a chapter on treatment, which consists largely of hints and general directions, was included.

Some statements do not coincide with generally accepted experience. Some of these are, "Uremia is defined as the abnormal elevation of blood urea resulting from intrinsic renal disease," and "Paroxysmal epigastric pain is part of the symptomatology of acute malignant nephrosclerosis in about 25 per cent. of the patients and may be the most prominent subjective symptom." Others are, "Its symptoms (hypertension in pregnancy) result from widespread vasoconstriction" and, elsewhere, "Treatment of hypertensive disease is rational only when it is directed to the ultimate cause." The useful and sensitive index of renal function obtainable from observations of urinary concentrating power is rather summarily dismissed. The rationale of the author's control of thiocyanate concentration in the body by a determination of its residue (intake-excretion) is not apparent, since this substance is distributed within the widely variable

compartment of extracellular water. If, as seems the case, concentration in the blood is the determinant of toxicity, such an approach introduces the possibility of error which approaches 50 per cent. The authors' distrust of this drug is not shared by the majority of clinicians.

A similar nihilism underlies the approach to the treatment of hypertension in unilateral renal disease by nephrectomy. Their conservatism will, we hope, serve to counter the reckless optimism of certain surgeons. But, since it seems an unnecessarily extreme point of view, it may not be given the weight it should have.

An interesting chapter on peripheral resistance is included. The appendix includes succinct descriptions of the methods for its determination and for the study of renal function by the author's methods.

This is a provocative book which reflects and summarizes the author's experience. It is therefore welcome. Disagreement concerning some of its conclusions should, we trust, serve to stimulate efforts to resolve the areas of doubt.

VASCULAR RESPONSES

Vascular Responses in the Extremities of Man in Health and Disease. By D. I. ABRAMSON. Chicago: University of Chicago Press. 1944. $5.00.

DR. ABRAMSON'S book, "Vascular Responses in the Extremities of Man in Health and Disease," reviews his material in critical and comprehensive fashion. The richness of the bibliography is to be commended. After a detailed description of methods for studying peripheral blood flow, the physiologic responses of the blood vessels in different portions of the extremities are described. This is followed by consideration of the responses to various pharmacologic agents, of blood flow in abnormal states and in systemic disease, of peripheral vascular disease, and finally, by an evaluation of methods of treatment of peripheral vascular disease.

The sections on peripheral vascular disease are particularly good and may be read with profit by clinicians. They might be read first, the more so because the detail of the sections on methods and physiological variations might strain the average clinician's patience. The latter will prove especially valuable to physiologists.

In some places the author seems to stretch the interpretation of the results obtained by the plethysmograph. This instrument has not yet reached either qualitative or quantitative perfection. For instance, his results cast doubt upon the view that the arterial hypertonus in hypertension is generalized and is due to a circulating vasoconstrictor substance. Quite apart from the possibility of methodical error, more consideration should be given to the differences in response of peripheral and central arterial beds. Thus the evidence is inadequate indeed for such an important conclusion. But, on the whole, facts are critically, impartially and completely presented.

There is much to recommend books of this type in which a central theme, blood flow in the extremities, is used as the trunk on which to graft knowledge of both the physiology and pathology of the blood vessels. Abramson has done his task well.

IRVINE H. PAGE
A. C. CORCORAN

AQUARIUM ANIMALS

Guide to Higher Aquarium Animals. By EDWARD T. BOARDMAN. Cranbrook Institute of Science. 1944. $2.00.

IN 107 pages Dr. Boardman has tersely and thoroughly covered this subject. If you live in Michigan or thereabouts and wish to stock and maintain an aquarium or vivarium with fish, amphibians or reptiles this is your *vade mecum.* My guess is that at least 75 per cent. of the facts presented apply in general to an aquarist in New York or California as well. From lampreys to turtles all the better-known forms are represented by an illustration and brief paragraphs on appearance, size, habitat, breeding habits and food. Full credits are given for the good illustrations, the diction is authentic and clear, the type and format are excellent, and appendices deal with aquaria, their water and management, and hints as to parasites and some common diseases. This is a companion volume to the author's "Field Guide to Lower Aquarium Animals."

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SPECIAL ARTICLES

BULBAR INHIBITION AND FACILITATION OF MOTOR ACTIVITY[1, 2]

SINCE Sherrington's discovery of decerebrate rigidity in 1898, it has been known that the bulbar portion of the brain stem exerts an excitatory influence on neural motor systems, particularly those activating the extensor muscles of the body. That this bulbar region, in addition, contains a mechanism capable of exerting a general inhibitory influence on motor activity does

[1] Aided by a grant from the National Foundation for Infantile Paralysis.

[2] Grateful appreciation is expressed to Dr. W. F. Windle, director of the Institute of Neurology, for the loan of most of the apparatus employed in this study.

not appear to have been recognized. It was with some astonishment, then, that electrical stimulation of the bulbar reticular formation in the cat was found to bring completely to a halt motor activity whether induced reflexly, by brain stem mechanisms or from the motor cortex.

In the records shown in Fig. 1 A and B, the blink

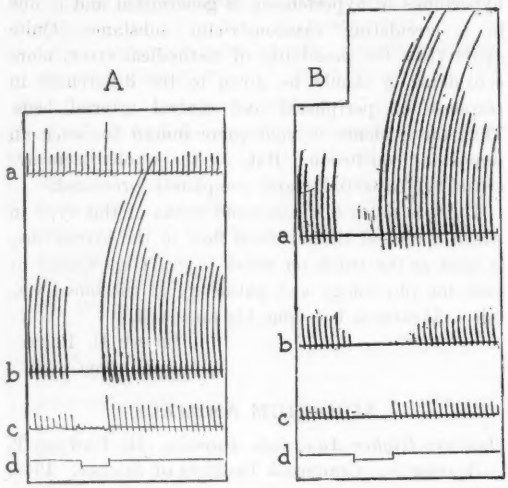

FIG. 1. A and B. Effect of bulbar stimulation (d) on flexor reflex (a), knee jerk (b) and blink reflex (c), evoked at 2 second intervals. Chlorolosane anesthesia. In all records the bulbar stimulus consisted of 60 cycle current at 3–5, R. M. S. volts.

reflex of the eyelids (c), the flexor reflex of the foreleg (a) and the knee jerk in the hindleg (b), evoked at 2-second intervals, were abolished by bulbar stimulation during the period marked by the signal (d). These reflexes, initiated respectively by tactile, nociceptive and proprioceptive stimuli, involve muscles—posturally indifferent, flexor and extensor—distributed over the length of the body. The bulbar inhibitory influence thus appears to be a general one, not limited in its action to topographically circumscribed or to functionally specific reflex acts.

The effect of bulbar stimulation upon decerebrate rigidity was observed visually with the animal supine and its legs extended in the air. Upon stimulation the limbs became flaccid and collapsed and their reflexes were lost. At the cessation of the stimulus extensor hypertonus and reflex activity promptly returned. In Fig. 2 A, flexion of the hindleg (a), induced by activating descending fibers from the motor cortex in the internal capsule (c), was abolished by stimulating the bulbar reticular formation (b).

In some of the instances illustrated (Fig. 1 A, b and c; Fig. 1 B, a; Fig. 2 A, a), the bulbar inhibitory effect was followed at the cessation of the stimulus by a subsequent augmentation of whatever motor activity was proceeding, a phenomenon attributed in other situations to the activation of intermixed inhibitory and facilitatory elements. Perhaps supporting this interpretation was the observation of purely facilitatory responses (Fig. 2 B, a) elicited from adjacent regions of the medulla.

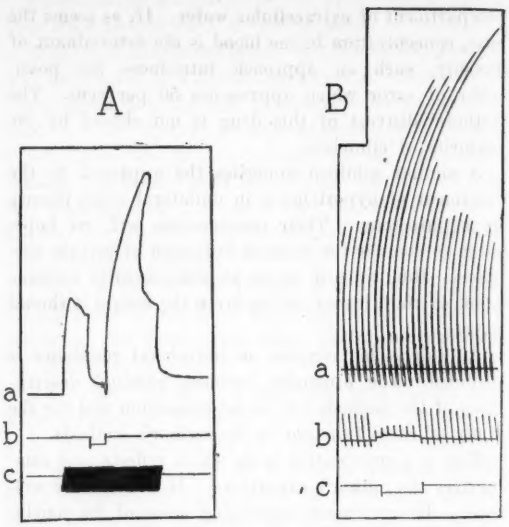

FIG. 2. A. Effect of intercurrent bulbar stimulation (b) on flexion of the hindleg (a) induced by activating the internal capsule (c) with induction shocks. Nembutal anesthesia. B. Effect of bulbar stimulation (c) on knee jerk (a) and blink reflex (b). Chlorolosane.

Retention of bulbar inhibitory and facilitatory responses after low decerebration excluded the possibility that they resulted from activating ascending pathways to higher neural levels. Similarly, they were unimpaired after decerebellation. The possibility that they were evoked by activating descending pathways simply coursing through the medulla has not been so certainly eliminated, though no comparable general effects have yet been obtained by midbrain stimulation.

At this preliminary stage, the relation of the bulbar mechanism described to other motor components of the nervous system can only be conjectural, but the duality and widespread distribution of the effects of its activation certainly suggest its potential importance in the regulation of motor activity.

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RELATIONSHIP OF PENICILLIN THERAPY TO BRAIN INVOLVEMENT IN EXPERIMENTAL RELAPSING FEVER[1]

PREVIOUS papers[2, 3, 4] on the therapeutic efficacy of

[1] From the Department of Bacteriology, the University of Texas, Austin, Texas.

penicillin in experimental relapsing fever have reported the use of the old rat passage strain of *Borrelia recurrentis* (*novyi*). The heavy inocula used have resulted in massive infections in time intervals which are never experienced in natural infections. Reported "cures" have not taken into consideration the well-known fact of brain involvement in experimental relapsing fever.[5]

The 45 rats employed in the treatment phase of our experiment were infected by intraperitoneal injections of 0.01 cc of onset blood (1 to 5 spirochetes per 100 dark fields) from tick (*O. turicata*) infected rats or from rats not more than six onset blood passages away from tick infection. Incubation periods ranged from 2 to 5 days and maximum infections were attained in 4 to 7 days. The infection status was established by the daily examination of uniform dark-field preparations of tail blood (0.01 cc of a 1:20 dilution).

The infection in the late treatment group of 25 rats was allowed to progress to late first attack or to early or late relapse stages (2 to 18 days after dark-field onset) before treatment was begun. Treatment was begun in the early treatment group of 20 rats on the day that spirochetes were first observed in dark-field preparations (1 spirochete per 176 to 6 spirochetes per 100 dark-fields). The 45 animals were subdivided into the following 9 groups of 5 each on the basis of infection status and treatment dosage. Rats of approximately equal weights were distributed among the various groups:

Late Treatment Group:

Group I—Treated with 7,600 Oxford units of penicillin beginning 2 to 6 days after dark-field onset.

Group II—Treated with 7,600 Oxford units of penicillin beginning 14 to 15 days after dark-field onset.

Group III—Treated with 3,800 Oxford units of penicillin beginning 9 to 18 days after dark-field onset.

Group IV—Treated with 1,900 Oxford units of penicillin beginning 12 to 15 days after dark-field onset.

Group V—Controls not treated. Dark-field onset 14 to 15 days before treatment of test animals was begun.

Early Treatment Group (Treatment was begun on day of dark-field onset):

Group VI—Treated with 7,600 Oxford units of penicillin.

Group VII—Treated with 3,800 Oxford units of penicillin.

Group VIII—Treated with 1,900 Oxford units of penicillin.

Group IX—Controls not treated. Dark-field onset on day treatment was begun in test animals.

All animals were treated concurrently by the intraperitoneal route, at intervals of 4 hours for 72 hours. Groups I, II and VI received an initial dose of 800 units followed by 17 doses of 400 units each. Groups III and VII received an initial dose of 400 units followed by 17 doses of 200 units each. Groups IV and VIII received an initial dose of 200 units followed by 17 doses of 100 units each.[6]

The 20 animals in Groups VI through IX were examined microscopically at intervals of 1, 5 and 25 hours after the initial dose of penicillin and daily thereafter for 10 days from the date of infection. The results of these examinations tend to confirm the previously reported ability of adequate doses of penicillin (in our case between 6,000 and 12,900 Oxford units per kg of rat) to clear the blood stream of experimentally infected animals of microscopically demonstrable spirochetes within 5 to 6 hours. Whether or not this 5-hour blood clearing dose constituted a curative dose in these animals remains to be established. These rats continued to receive penicillin, and 7 of the 8 later proved to be cured. The 8 rats which showed blood clearing (5 of Group VI and 3 of Group VII) received total penicillin dosages equivalent to between 38,400 and 81,700 units per kg body weight. The 7 rats (2 of Group VII and 5 of Group VIII) which either failed to clear or relapsed received total penicillin dosages equivalent to between 9,400 and 26,700 units per kg body weight. The five control animals (Group IX) showed 2 to 28 spirochetes per 100 dark-fields at the 5-hour examination. These infections progressed to maxima of 3 to 40 spirochetes per field.

Seven days after the termination of treatment the 44 surviving rats were sacrificed and the brains from these animals were inoculated intraperitoneally to fresh rats. Uniform dark-field preparations from these brain passage rats were examined daily for 10 days.

The 25 brain passage rats from Groups I through V (late treatment rats) all became positive, indicating that either the brain or blood or both still harbored spirochetes. The total penicillin dosage received by the test animals in this group ranged between 5,100 and 48,100 Oxford units per kg. Seven of the 10 animals in Groups I and II received more than 40,000 units of penicillin per kg, but were not rendered negative to brain passage.

In the early treatment group, the brains from 7 of the 8 rats which showed microscopic blood clearing failed to infect the rats to which the brains were passed. Thus it would appear that adequate penicillin

[2] F. R. Heilman and W. E. Herrell, *Proc. Staff Meetings Mayo Clinic*, 18: 457–467, 1943.

[3] Donald L. Augustine, David Weinman and Joan McAllister, SCIENCE, 99: 19–20, 1944.

[4] Harry Eagle and Harold J. Magnuson, *Pub. Health Rep.*, 59: 583–588, 1944.

[5] A. Buschke and H. Kroo, *Deutsch. Med. Wschr.*, 49: 1435–1436, 1923.

[6] We wish to thank Dr. J. W. Foster, of Merck and Company, for sending a vial of standard penicillin and Miss Grace Beal, of the Brucellosis Research Project of the Clayton Foundation, the University of Texas, for checking our penicillin dosages.

dosage given early in experimental relapsing fever (*B. recurrentis* var. *turicatae*) infection will not only cure the blood stream involvement but will prevent brain involvement in a great majority of the cases. The fact that the 1 positive brain passage in this group of 8 animals occurred in a rat which received 45,000 units of penicillin per kg, whereas in two other instances 38,400 and 41,300 units per kg prevented brain involvement, indicates that even early treatment with apparently adequate dosage will not prevent brain involvement in all cases. Also the fact that brain passage was positive in the 7 late treatment rats of Groups I and II which received more than 40,000 units per kg is strong presumptive evidence that adequate dosage for early treatment is not adequate dosage for late treatment. The question of whether or not brain involvement can be cured with any dosage of penicillin remains to be solved.

This is a preliminary report, and complete details and additions will be published elsewhere. We believe that the question of brain cure or prevention of brain involvement in spirochetoses is a most important consideration and that the results of our experiments reemphasize the need for early treatment and adequate dosage in relapsing fever therapy.

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PRECIPITATION AND AGGLUTINATION TESTS WITH THE HEMOLYTIC STREPTOCOCCUS. TITRATION OF "M" AND "T" ANTI-BODIES IN HUMAN SERA

THE determination of the predominating "M" and "T" antigens by means of precipitation or agglutination tests is the accepted means of identifying hemolytic streptococci as to type in epidemiological studies of human infection. Since such investigations are frequently subject to error due to a multiplicity of antigens in the strains isolated or to the presence of cross infections, it seemed possible that the type implicated in any given infection might be more readily ascertained if it could be shown that type-specific antibodies are produced in the patient's serum in sufficient strength for identification by means of either precipitation or agglutination tests using antigens of known specificity.

In the course of studies at the U. S. Naval Training Station at Newport, R. I.[1] in 1941, blood sera from naval recruits were made available for the determination of antibody content. Forty samples of serum were tested for specific agglutinins by slide agglutination. Nine were from cases of upper respiratory infection—either sore throat or scarlet fever, and eleven were from cases of rheumatic fever. In each instance, the hemolytic streptococcus isolated from the throat was typed by agglutination at the time of hospitalization. Twenty sera from well recruits were included as controls. In a few cases hemolytic streptococci were isolated from the throat cultures in this group also, and the type established.

The sera were tested in dilutions ranging from 1–1 to 1–2,000, from six to eighteen dilutions being set up in each case as needed. All cultures for the agglutination tests were from the type collection of the Department of Preventive Medicine of the Harvard University Medical School. Since "T" antigen[2] is apparently constant and unrelated to colony morphology, it seemed justifiable to use these cultures without continuous mouse passage. Suspensions were prepared from 20- to 22-hour cultures grown at 37° C. in 5 cc broth prepared according to the formula of Swift and Hodge.[3] Before use, the supernatant fluid was pipetted off and the sedimented cells resuspended to a uniform density in a small volume of broth. The slide agglutination technique of Griffith[4] was followed, readings being made after a brief agitation of the serum dilution-suspension mixtures. Control suspensions were included on each slide to eliminate any possibility of error due to spontaneous agglutination. The type cultures used formed smooth suspensions with the exception of types 6 and 13, which frequently had to be prepared from cultures grown at room temperature to ensure stable suspensions.

Cross reactions were common in all the sera and the more sensitive suspensions showed agglutination in relatively high dilutions. Agglutination in dilutions 1–5, 1–10 and 1–20 were frequent. However, agglutinins of sufficient strength or specificity to indicate an antibody response related to either present or past infection could not be demonstrated. In no instance could correlation be shown between serum agglutinins and the streptococcus type isolated from the throat cultures. Heterologous agglutinins were present to the same or even higher titre than those of homologous type. Moreover, the control sera showed cross reactions of the same magnitude and complexity.

Although these experiments seemed to indicate that the presence or absence of "T" antibodies in human sera have little significance, it was hoped that comparable tests for "M" antibodies would show more conclusive evidence of correlation between antibody content

[1] Captain R. M. Lhamon (M.C.), U.S.N.; Commander R. W. Huntington (M.C.), U.S.N.R.; Lieutenant S. M. Wheeler (M.C.), U.S.N.R., and T. Duckett Jones, M.D. To be published.

[2] Rebecca C. Lancefield, *Jour. Exp. Med.*, 71: 521–550, 1940.

[3] Homer F. Swift and B. E. Hodge, *Proc. Soc. Exp. Biol. and Med.*, 30: 1022–1023, 1933.

[4] F. Griffith, *Jour. Hyg.*, 34: 542–583, 1935.

and infection type. Eleven sera from rheumatic fever patients were subsequently tested, using crude extracts of "M" antigen supplied by Dr. Lancefield's laboratory in connection with another study.[5] Precipitation tests were carried out by the capillary technique of Swift, Wilson and Lancefield.[6] The sera employed were obtained from the same rheumatic fever patients but represented different bleedings. No precipitation could be demonstrated at 37° C although reactions did occur in several of the sera after exposure overnight at ice-box temperature. This, together with the fact that cross reactions were numerous, would seem to indicate an indefinite antibody response of an unspecified nature between the unabsorbed sera and the "crude" extracts of "M" antigen employed. None of the sera showed the prompt precipitation with homologous extract which might logically be expected if true anti-"M" were present. As in the case of the agglutinins, correlation between antibodies produced, either as regards amount or specificity, and infection could not be demonstrated.

More conclusive evidence of the absence of relationship between "M" antibody and infection type in rheumatic fever was shown by the results of precipitation tests on sera from a rheumatic fever patient under treatment in the House of the Good Samaritan in Boston, Massachusetts. Three bleedings were obtained over a six-week period, during which throat cultures were taken at frequent intervals. From these, hemolytic streptococci were isolated on six occasions which, in each instance, agglutinated as type 12/28. In the precipitation tests on these sera, the crude "M" extracts and the technique employed were the same as those used in the tests on the Newport cases. Complete absence in reaction at 37° C and a multiplicity of cross reactions at ice-box temperature were again demonstrated.

SUMMARY

While "M" and "T" antibodies can be demonstrated in low titre in human sera, an almost complete absence of specificity seems to indicate an apparent lack of correlation with current or past streptococcal illness. In the present study, agglutination and precipitation tests on patient's sera, using known "T" and "M" antigens, appear to have little value in determining the antigenic relationship of the streptococci involved in infection. Moreover, no correlation could be shown between the amounts of "M" antibody and of "T" antibody present in the different sera.

It is obvious that further work is needed. With a greater degree of purification of "M" and "T" and the elimination of non-specific substances, it may ultimately be possible to demonstrate the development of significant type-specific antibodies in human sera.

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[5] Obtained from Br. B. F. Massell, House of the Good Samaritan, through the courtesy of Rebecca C. Lancefield.

[6] Homer F. Swift, Armine T. Wilson and Rebecca C. Lancefield, *Jour. Exp. Med.*, 78: 127–133, 1943.

LENGTH OF SURVIVAL OF HOMOZYGOUS CREEPER FOWL EMBRYOS

EXTENSIVE studies on Creeper fowl have established that the Creeper factor has a lethal effect when homozygous. The homozygous Creeper embryos generally die soon after the end of the third day of incubation, but a few survive to later stages. These late homozygous Creeper embryos are readily recognizable by complex deformities of the extremities (phokomelia), the eyes and other parts.

It was observed repeatedly that a higher percentage of homozygous Creeper embryos survived beyond the early lethal stage when, prior to incubation, the temperature of the egg storage room had risen considerably above physiological zero, *i.e.*, above the temperature below which no development occurs in chicken eggs. This suggested that initial development at a lower rate than that prevailing at standard incubation temperatures favors the survival of larger than usual numbers of homozygous Creeper embryos to late stages. Systematic tests have now been made to verify the correctness of this assumption.

Our routine incubation is done in a forced-draft incubator running between 99° and 100° F. The standard temperature of still-air incubators is 103° F. Our tests consisted in starting eggs from Creeper matings in a still-air incubator running at 96° F. and to transfer them to standard conditions of a forced-draft incubator after 12, 24 and 48 hours, respectively. The control eggs were throughout incubated in the same forced-draft incubator. Eggs of the same hens were distributed evenly into test and control groups.

The results of these experiments are shown in Table 1. There was no difference in the frequency of late homozygous Creeper embryos when the eggs had been incubated for only twelve hours at reduced temperature. When, however, the duration of lowered tem-

TABLE 1

Duration of reduced initial incubation temperature (96° F.) in hours		12	24	48
Test group	N	310	627	574
	Number of late CpCp embryos	8	27	13
	Hatch per cent.	42.4 ± 2.85	54.0 ± 2.03	58.9 ± 2.04
Control group	N	309	609	570
	Number of late CpCp embryos	6	10	7
	Hatch per cent.	52.0 ± 2.88	55.9 ± 2.03	55.0 ± 2.09
Significance of differences in frequency of late CpCp embryos	χ^2	0.034	7.495	1.832
	P	> .80	< .01	> .10

perature was extended to the first 24 hours of incubation, there was a 170 per cent. rise in the frequency of survival of homozygous Creeper embryos as compared with the control group. This difference is clearly significant. When the time of incubation at reduced temperature was increased to the first 48 hours the advantage to the homozygous Creeper embryos, as reflected in survival, disappeared.

The fact that a lowered rate of development for the first 24 hours favors increased survival of homozygous Creeper embryos, but that the same did not hold when the reduced temperature lasted for as much as 48 hours, requires explanation. The reasons can only be surmised. When the temperature of incubation was brought down to 93° F. for as long as seven days, the majority of embryos died during the second week of development and hatchability was reduced to zero. Even after as short a period as four days at 93° F. only 37 per cent. of the fertile eggs hatched, as compared with 56 per cent. of the controls (eggs from Creeper matings). It is evident, then, that prolonged exposure to a reduced developmental rate is harmful. Although such a harmful effect can not be discerned after 48 hours of incubation at 96° F., as judged by hatching results, it seems reasonable to assume that the beneficial effect which a reduced developmenal rate has on survival of homozygous Creeper embryos is vitiated by harmful agencies which come into play if the duration of lowered developmental rate is extended beyond an optimum.

The fact that more homozygous Creeper embryos survive to late stages when the first 24 hours of their development proceed at a reduced developmental rate fixes the activity of the homozygous Creeper condition at a considerably earlier embryonic period than it has been possible to demonstrate by morphological means. It may also be concluded from these observations that the improved chances of survival of homozygous Creeper embryos under the conditions of our experiment indicate that the production or utilization of a critical substance or the occurrence of some chemical transformation has been aided.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

FLUORESCENT STAINING OF INSECT TISSUES

THE staining of plant and animal tissues by means of fluorescent substances has come into use during recent years and numerous materials have been found suitable for this purpose. Known as fluorochromes, these act specifically to stain certain cellular structures, in a way comparable to the more commonly used microscopical stains like haematoxylin and various aniline dyes. While the latter are ordinarily viewed by transmitted white light or by certain other bands of the visible spectrum, fluorochromes show practically no color until irradiated by ultra-violet light. Thus illuminated, the stained structures fluoresce and appear as a brilliantly luminous pattern whose color (most commonly yellow) is that characteristic of the specific stain used. Fluorescence is usually most strongly activated by the longer wave-lengths of ultra-violet, especially those near λ3650 which are particularly strong in the light of mercury-vapor lamps. These, then, form a satisfactory source of illumination. The insertion of a "black" Corning glass filter (such as Wratten No. 18) between the lamp and the microscope removes the visible light (except a little red) and all the ultra-violet below about λ3100. Thus the light is perfectly safe for visual work, especially if a light yellow protective filter (such as Wratten No. 2a) is interposed between the microscope and the eyes.

The dyes earlier used by Haitinger and his associates[1] included a few plant extracts, alkaloids and dyes of various sorts whose staining properties these workers investigated briefly. More recently a number of other substances have been found to be satisfactory fluorochromes for certain purposes, for example, the use of auramin as a stain for bacteria, especially in the diagnosis of tuberculosis.

Following a simple procedure of fixing in 5 per cent. formalin followed by the ordinary methods of dehydration in alcohol, clearing in xylol, imbedding and cutting in paraffin, sections may be stained in aqueous solutions of the fluorochromes and examined under the microscope after mounting in glycerin. The latter is not fluorescent and must replace the ordinary balsam or other media which are highly fluorescent and "fog the picture," as will also the use of oil-immersion objectives, due to the natural blue fluorescence of immersion oils.

The application of several of these dyes to the staining of insects' tissues has been reported on by Metcalf and Patton,[2] who have used berberine extensively, finding it to be a powerful stain which differentiates nuclei very clearly as it causes the chromatin to fluoresce a brilliant light yellow.

A number of specific alkaloids, or these in mixture as obtained by extracting the roots, bark or other

[1] *Bot. Centralbl., Beihefte,* 50: pp. 432–444, 1933; *ibid.,* 53, pp. 378–396, 1935; *ibidem,* pp. 387–397; Abderhalden's Handb. d. Biol. Arbeitsmeth., Abt. II, Physik. Abt., Teil 3, Heft 5, Lief, 433, pp. 3307–3337, 1934.

[2] *Stain Technology,* 19: 11–27, 1944.

parts of the plants containing them, have shown that fluorescent stains may be obtained from a considerable variety of plant species. One of the first to be used was an extract of the roots of the greater celandine (*Chelidonium majus*), a European weed now naturalized in the eastern United States. We have used alcoholic extracts of the roots of this species and also ones prepared from several related native American papaveraceous plants, especially species of Argemone and the common blood-root (*Sanguinaria Canadensis*). All these act as powerful yellow fluorochromes, as does also the alkaloid, sanguinarine nitrate, kindly supplied to us in purified form by the S. B. Penick Company of New York City. The brilliant yellow bark of the Asiatic cork-tree (*Phellodendron amurense*) forms another particularly good stain, due possibly to the berberine that it contains, although the color is a deeper yellow than that produced by pure berberine or by an extract of some of our common horticultural forms of barberry, which stain by virtue of their considerable content of berberine. Phellodendron is a member of the natural family Rutaceae.

It appears thus that fluorescent alkaloids or other materials which act as fluorochromes, and consequently as efficient biological stains, occur in various groups of flowering plants. In some cases this would seem to be due to the rather wide distribution of a berberine type of alkaloid among members of several families of plants (*e.g.*, Ranunculaceae, Papaveraceae, Berberidaceae, Rutaceae). However, the vigorous staining properties of purified sanguinarine indicate that action of the blood-root extract can not depend entirely on its berberine content.

This case is particularly interesting, since it has been shown that sanguinarine, like colchicine, can induce polyploidy in certain plants (Antirrhinum).[3] Although brilliantly fluorescent in solution, colchicine does not act as a nuclear stain on any of the materials with which we have tested it.

A preliminary survey, including a considerable number of native plants, has disclosed only a few that may be expected to serve as satisfactory biological stains. Most notable among these are Sanguinaria and the gold-thread, *Coptis trifolia*. The great majority of extracts made from roots, stems or bark are brightly fluorescent, commonly blue, yellow or white, but the fluorescence of the solution is no indication that it will act as a fluorochrome. The same is true of numerous therapeutic alkaloids, most of which are fluorescent, often brilliantly so.

We have not yet been successful in finding any material that will act as a blue fluorochrome, although this color is so frequently encountered in plant extracts and alkaloids, and is characteristic of the natural fluorescence of some insect tissues, especially that of striated muscle.

Fluorescin and auramin O and, more lately, acridine orange, acridine yellow, acriflavine and rivanol (ethoxydiamine-acridine) have been recommended as fluorochromes, but in our experience, these have proved inferior to the alkaloids mentioned above. They do not give the brilliant differentiation of nuclei and other cellular structures that is characteristic of these fluorochrome-alkaloids.

The fluorochromes stain at very great dilutions in aqueous solution after immersion of the sections for half an hour or longer, and the preparations commonly retain their fluorescent properties for many days, provided of course that they are stored in a dim light.

Staining with a series of solutions buffered over a considerable range of hydrogen-ion concentration shows a great variation in brilliancy, but a neutral solution (near pH 7) seems to be quite universally the most satisfactory for a number of fluorochromes tested in this way.

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[3] T. M. Little, SCIENCE, 96: 188–189, 1942.

A CONCENTRATED BASAL MEDIUM FOR MICROBIOLOGICAL VITAMIN ASSAY

THE Snell and Strong microbiological assay for riboflavin[1] as improved by Strong and Carpenter[2] is used successfully in many laboratories and in general is accepted as a speedy, highly quantitative method for the determination of riboflavin in a wide variety of biological materials. Of equal success has been the application of the Snell-Wright microbiological assay for niacin[3] as modified by Krehl, Strong and Elvehjem.[4]

In stride with the increased importance and demand for the evaluation of biological materials in terms of their nutritional value, workers in this field of biochemistry have sought to standardize their methods in order to cooperate successfully in certain collaborative studies pertinent to their efforts. The development and improvement of the above methods have partially fulfilled the demand for such standardization. However, recent collaborative studies have revealed to us a wide difference in method of preparation and storage of the basal media used in the above assays.

[1] E. E. Snell and F. M. Strong, *Ind. and Eng. Chem.*, 11: 346, 1939.
[2] F. M. Strong and L. E. Carpenter, *Ind. and Eng. Chem.*, 14: 909, 1942.
[3] E. E. Snell and L. D. Wright, *Jour. Biol. Chem.*, 139: 675, 1941.
[4] W. A. Krehl, F. M. Strong and C. A. Elvehjem, *Ind. and Eng. Chem.*, 15: 471, 1943.

It occurred to us, therefore, that a basal medium of constant composition would be of great value in routine control assay work as well as in collaborative research. The preparation of a basal medium possessing the above qualities has been successfully accomplished in our laboratory and has prompted our describing it here.

In the preparation of the riboflavin basal medium alkali-treated photolyzed peptone, l-(-)-cystine and a yeast supplement, prepared and combined in the generally accepted manner,[1,2] were dissolved in a minimum quantity of distilled water (approximately 5.0 per cent. solids) and adjusted to pH 6.6–6.8 with 5N sodium hydroxide using brom thymol blue as an outside indicator. The solution was then dried from the frozen state for a period of thirty-six hours after which the dehydrated residue was removed and stored over phosphorus pentoxide at room temperature. A 2.25 per cent. solution of the desiccated product was used for the riboflavin basal medium to which was added anhydrous glucose at a level of 2.0 per cent. Results with this basal medium over a period of twelve weeks are summarized in Table 1.

TABLE 1

THE RESPONSE OF LACTOBACILLUS CASEI TO RIBOFLAVIN ON A 2.25 PER CENT. SOLUTION OF A CONCENTRATED BASAL MEDIUM STORED AT 75° F. OVER PHOSPHORUS PENTOXIDE FOR A PERIOD OF TWELVE WEEKS

	Lactic acid production (cc N/10 NaOH)									
Micrograms riboflavin	Trial No. 1	Trial No. 2	Trial No. 3	Trial No. 4	Trial No. 5	Trial No. 6	Trial No. 7	Trial No. 8	Mean	Mean per 0.05 microgram increments of riboflavin
0.00	1.15	1.50	1.95	1.65	2.30	2.10	1.40	1.50	1.69	...
0.05	3.20	3.50	4.60	3.40	4.25	4.05	3.60	3.70	3.78	2.09
0.10	5.55	5.85	6.65	5.60	6.55	6.30	6.35	6.00	6.11	2.33
0.15	7.50	8.20	8.30	7.45	8.65	8.75	8.40	8.15	8.18	2.07
0.20	8.90	9.30	9.65	8.40	9.70	10.00	9.80	9.20	9.37	1.19
0.25	9.75	10.30	10.50	9.00	10.05	10.55	10.25	9.60	10.00	0.63
0.30	10.25	10.55	10.80	10.10	10.75	11.05	10.55	10.65	10.59	0.59

A dehydrated basal medium for the assay of niacin has been obtained in a similar manner. Ingredients of the medium were prepared and combined in the proportions described by Krehl and co-workers.[4] In addition, a "folic acid" concentrate was added. The desiccated product was stored over phosphorus pentoxide at room temperature as in the case of the riboflavin basal medium. A 2.0 per cent. solution of this product was used for assay purposes. Anhydrous glucose and sodium acetate were added at a level of 4.0 per cent. Preliminary data obtained with this basal medium over a storage period of three weeks indicate results as successful as were obtained with the riboflavin basal.

Results obtained on the above described concentrated basal media are encouraging from the standpoint of standardization of microbiological assay methods. Many variables affect reproducibility of standard curves in the average control laboratory. Practical variations in incubation time, use of different incubators whose temperature controls vary in precision, different operators and the use of several lots of only approximately standardized alkali contribute to variations in standard curves. It has been impossible in this preliminary work to attempt rigid control of these various factors. We believe, therefore, since the basal used throughout this study was from a homogenous lot and since there is no apparent trend in variability, that this medium has maintained its original characteristics for a period of twelve weeks.

In view of these conclusions, together with the economy of time involved, it seems feasible that this type of product is justified for general use in microbiological assay.

Investigations are underway on the preparation of such basal media for pantothenic acid and "folic acid" as well as for media used in the microbiological assay of the amino acids. A complete manuscript describing details of the procedure involved will appear later.

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SCIENCE NEWS

Science Service, Washington, D. C.

NEW AND IMPROVED AIRFIELDS

THE chance that your city or town will have its own new or improved airfield looks promising if Congress passes the billion-dollar master airport plan just submitted to it by the Civil Aeronautics Administration. The plan asks that Congress appropriate $100,000,000 a year for the program over a period of five to ten years, which if carried out would result in a maximum of 6,000 new or improved flying fields for the nation, designed to accommodate everything from the small private "flying jeep" to long-range giants of the sky.

The plan follows a precedent established by the Public Roads Program which has operated satisfactorily for many years on a 50–50 basis, the Federal Government supplying 50% of the funds needed to build the airport and state or local authorities supplying the remaining money.

In preparing the report, the CAA took into consideration population, trade, mail, airline traffic, applications already made for new airline routes, as well as other economic and geographic factors. The proposal calls for greater numbers of new airports for metropolitan areas, but at the same time recommends that facilities be set up for such sections of the country as Nevada, where vast spaces make the airplane a logical form of transportation.

The report points out that by investing $25,000,000,000 in public roads during the past 25 years the United States has become a nation on wheels, with 32,000,000 motor vehicles in operation in normal times. Using the same reasoning, the CAA believes that by sponsoring airport development, the nation will take to the air.

After the war, the report states, there will be approximately 350,000 Army and Navy flyers and 150,000 civilian pilots and students. Also interested in aviation will be 2,500,000 others who have been trained during wartime in aviation skills in the armed forces and almost an equal number employed in aircraft factories. It adds to these 250,000 students who are taking aeronautics courses in the high schools each year, and there is a total number of 6,000,000 prospective flyers. If the CAA is correct in its predictions, over nine million people will be actively interested in flying after the war.

The report points out the biggest drawback to the development of private flying is that the small airplane has little or no utility value for the average flyer. You cannot use your private plane as you do your automobile. The CAA hopes to increase the utility value of small planes by locating airports near the homes of potential flyers as well as close to their places of business, and near recreational areas, national parks, and other places to which they might want to fly. The majority of small airports to-day are located where the low cost of land and development was the primary consideration, rather than convenience to the users of the airport.

ITEMS

THE severe earthquake reported on December 7 had its epicenter somewhere in a wide region extending from southern Japan to the Jap-owned Bonin Islands. This preliminary determination was made by seismologists of the U. S. Coast and Geodetic Survey, on the basis of half-a-dozen reports wired through Science Service from observatories on this continent. The shock began shortly after midnight by U. S. reckoning: at 12:35 A.M., Eastern War Time. Instrumental magnitude was given as 8, which indicates an earthquake of the most severe type.

PROMPT recovery, thanks to penicillin, of three women suffering with anthrax is reported by Dr. Franklin D. Murphy, Dr. Alfred C. La Boccetta and Dr. John S. Lockwood, of the University of Pennsylvania, in the *Journal* of the American Medical Association. These are believed to be the first human patients with anthrax treated with penicillin. Successful use of the mold chemical in mice infected with anthrax was announced in October of this year by Dr. F. R. Heilman and Dr. W. E. Herrell, of the Mayo Clinic. The women treated by the Philadelphia doctors were wool workers. They suffered from an uncomplicated cutaneous form of the disease. Each had a painful sore on her skin which at first looked like a pimple but rapidly got larger, inflamed and discharging. Penicillin cleared up the skin condition rapidly and the women were well within nine or ten days. Larger doses, it is thought, would be equally effective in more severe skin infections and in cases in which the anthrax germ attacks internal organs.

THE pessimistic rule that whenever man discovers or establishes a new plant crop, some insect pest discovers it, too, has found no exception in the case of guayule, the rubber-producing shrub native to the desert of the Southwest and adjacent parts of Mexico which the war emergency has brought into serious, large-scale cultivation. A hitherto unrecognized species of aphid has been found infesting the roots of slightly wilted guayule seedlings at the U. S. government nurseries at Salinas, Calif. After a careful examination confirmed the fact that it is really a new addition to the army of known pests, Professor E. O. Essig, of the University of California, has given it the scientific name *Cerosipha californica*. It will be known by the common name of guayule aphid.

A SPECIAL coil spring, and a shock absorber, is the basis of a new suspension-type tractor seat which will take all the jolts out of riding the farm tractor over rough plowed land and ease the work of the driver. It may perhaps decrease the high degree of kidney and skeletal disorders among farmers blamed on the all-day-long tractor jarring. The new tractor seat was developed by the Monroe Auto Equipment Company, of Chicago, which developed and has made thousands of seats for war tanks. The coil spring is placed directly under the driver's seat, and the triple-action hydraulic shock absorber at the rear. The absorber is similar to those commonly used in automobiles. Together the two devices give stability that enables the rider to stay level while the tractor bobs over rough ground. The construction of the new device is simple and inexpensive.

Life FROM A PLASTIC BAG!

THE MAN ADRIFT here is drinking sea water. But it is sea water that he has made drinkable by chemicals and a filter contained in a VINYLITE plastic bag*. The plastic—produced by CARBIDE AND CARBON CHEMICALS CORPORATION—has been made possible by the availability of synthetic organic chemicals, in which this Unit of UCC specializes.

But the story behind VINYLITE plastics is far more than just the history of another chemical development.

Rather, this unusual substance is indicative of the way man can learn—through years of uninterrupted research in the basic and applied sciences—to make better material than nature. It is one more confirmation of the continuing progress that is achieved by co-ordinating research, development and engineering.

The importance of VINYLITE plastic in helping to solve such vital needs as fresh water at sea is typical, in terms of human progress, of the stature already attained by many of the 160 synthetic organic chemicals that CARBIDE AND CARBON CHEMICALS CORPORATION now has in commercial production.

▼

**There are good reasons why a VINYLITE plastic is used in desalting bags. It can't mildew or rust. It is strong and tough, scuff-proof and shock-proof. It is chemical-resistant and sun-resistant. It is lightweight, transparent and flexible. It is non-flammable and cleanable . . . Engineers and executives interested in this material are invited to write for the booklet, O-12 "Vinylite Plastic Sheet and Sheeting."*

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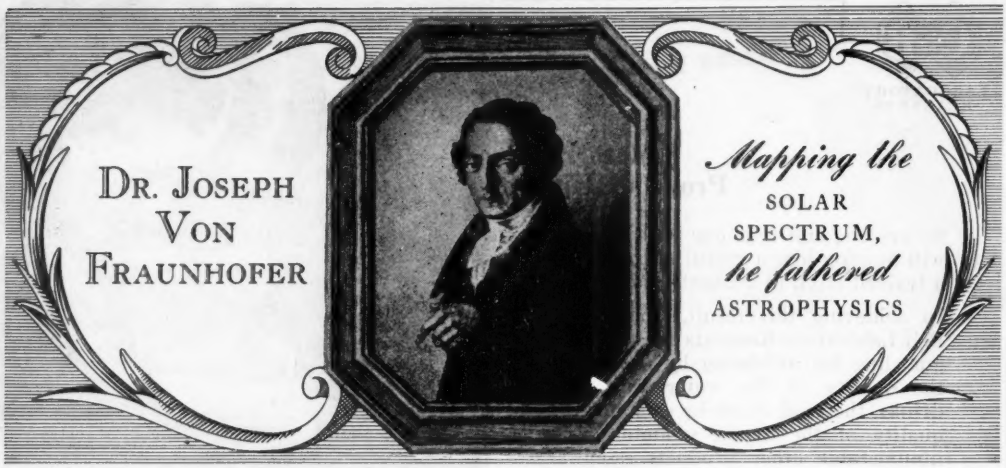
PLASTICS—Bakelite Corporation



WHEN Fraunhofer in 1814 added a telescope to Newton's glass prism and Wollaston's light-slit, he was able to locate 576 dark lines crossing the spectrum of the sun. These Fraunhofer lines, as they are now called, could not be seen by Newton and were merely noticed by Wollaston.

The young experimenter tried prisms of various transparent materials, and found that the dark lines could not be due to the prism itself. Then he examined the spectra of the moon and the planets, and terrestrial objects shining by reflected sunlight. Since the lines remained in all cases identical as to number and position, he knew that they were not caused by the atmosphere. When he studied the spectra of the stars, however, he saw that although the colors appeared in the same order, the dark lines had changed position and intensity. The character of the light source itself, then, must somehow be responsible for the lines, and we know now that they are the fingerprints of the atoms.

Fraunhofer invented the diffraction grating, but before he could use it in extending his study of spectra, he died at the age of 39.

THE PROGRESS OF RESEARCH

Newton to Wollaston to Fraunhofer and their many successors — so was research in the science of spectroscopy begun and developed.

Today, research is kept alive under the care of men in industry, education, and the armed forces — men to whom Perkin-Elmer has supplied instruments of increased accuracy, such as the infra-red spectrometer recently announced.

From contact with these men of science as well as from war-learned lessons in the quantity production of accurate optical parts, Perkin-Elmer has developed resources for new refinements in post-war scientific instruments.

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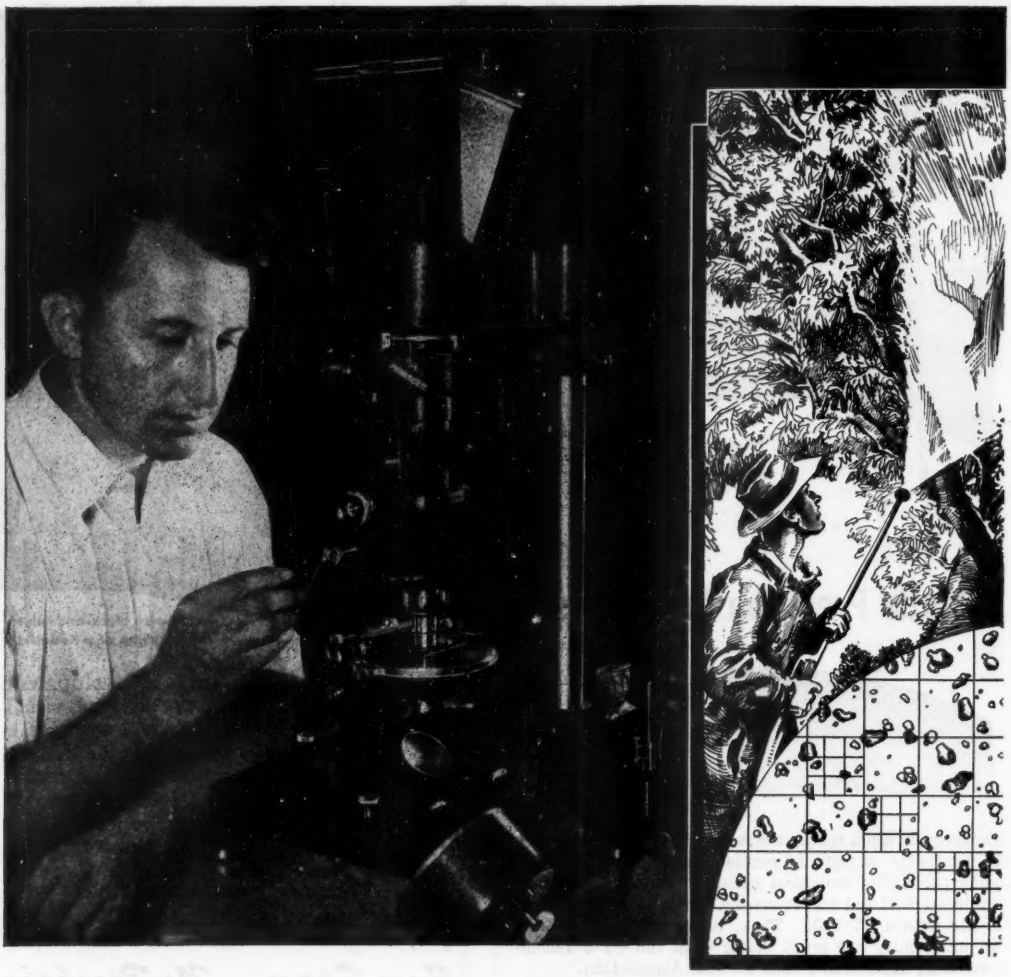

Microscopes and Agriculture

Agriculture, one of our oldest sciences, benefits constantly from scientific investigation and quality control.

The Spencer Microscope shown above, equipped for photomicrography, is in use in the Eastern States Milling Corporation, Buffalo Plant. Photomicrographs of wettable sulphur particles used in agricultural sprays help to establish and maintain a high standard in the finished material. Sprays are among the diversified products for farm use handled by Eastern States Farmers' Exchange.

For literature on Spencer Microscopes and other scientific instruments. write to Department M 3.

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